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214 THE MESODERMAL DERIVATIVES

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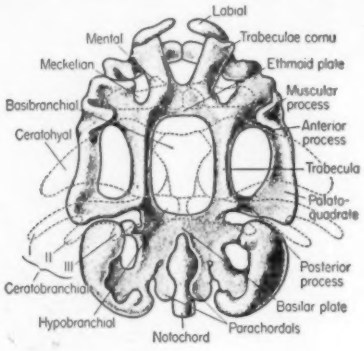

Rana pipiens embryonic chondrocranium. Dorsal view of the 11 mm. stage. Neurocranium is solid, labeled to the right. Splanchnocranium is in outline, labeled to the left. (After Gaup, from Ziegler.)

which arise by the ossification of cartilage and there are **membrane** (dermal) **bones** which develop from (dermis) superficial membranes without the intervention of a cartilage phase. These latter bones are sheet-like and can be stripped from the cartilage of the true cranium.

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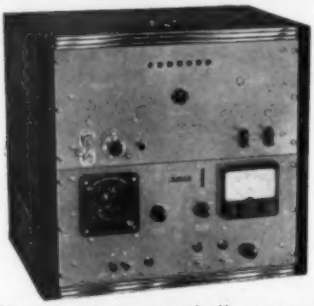

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Modern research has become enormously expensive. It must be supported by tremendous sums of money supplied by laymen, through direct or indirect taxation, even though those same laymen can in the very nature of things have little to say as to how that money is spent. A prime example of this is the development of atomic weapons, where decisions are taken by governments as a matter of public policy, but often with the utmost secrecy. These decisions may cost the taxpayer his life; they may penalize him in his enjoyment of the normal fruits of progress; they are almost certain to cost him a lot of money.

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Research Laboratory Dedication
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General Electric Review
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Productivity in Research and Development[1]

Ralph M. Hogan

Manpower Branch, Human Resources Division,
Office of Naval Research, Washington, D. C.

PRODUCTIVITY, perhaps the most difficult concept to define as a factor in the administration of research and development, is an intriguing area for research in manpower. What it meant by productivity? Or what are the criteria for judging the results of research and development activities? And assuming that criteria can be established, how can measures be developed for evaluating the performance of research and development workers? Let us assume, further, that means have been discovered for selecting individuals with aptitudes for research and development at a high level of proficiency, additional analyses must be made to search out the characteristics of highly competent research and development workers so that a real understanding can be applied to the evaluation of productivity. Only after such a basic understanding can the problem of productivity be solved from the following points of view: (1) developing research workers (including preservice education and in-service on-the-job education and training), and (2) managing these workers efficiently.

The program of research under the sponsorship of the Manpower Branch is directed toward providing more effective instruments for use in the selection, placement, training, and supervision of scientific and engineering personnel in research and development.

Factors Underlying Productivity

Two basic studies attempt to get at the factors underlying productivity: the determination of the characteristics of research and development workers through job analysis, and the discovery of the psychological factors involved.

Characteristics of productive scientists and engineers. The objective of this study, under John C. Flanagan, American Institute for Research, was the identification and definition of the characteristics of effective research and development scientists and engineers, as a basis for developing an instrument for evaluating the productivity of such workers. Through interviews with over 500 research workers in supervisory positions in 20 laboratories, descriptions of especially effective or ineffective on-the-job behaviors (3,347) were collected. A check list, giving both effective and ineffective behavior, was constructed for each unique group of behaviors. When items had been constructed for all the data, they were grouped into homogeneous and nonoverlapping units as a "Check List of Critical Requirements for the Evaluation of Scientific Personnel," under the following major areas of a scientist's work:[2]

1) *Formulating problems and hypotheses,* including identifying and exploring problems, defining the problem, and setting up hypotheses.

2) *Planning and designing the investigation,* including collecting background information, setting up assumptions, identifying and controlling important variables, developing systematic and inclusive plans for the use of equipment, materials, and techniques, anticipating difficulties, determining the number of observations.

3) *Conducting the investigation,* including developing methods, materials, or equipment, applying methods and techniques, modifying planned procedures, applying theory, attending to and checking details, analyzing data.

4) *Interpreting research results,* including evaluating findings and pointing out implications of data.

5) *Preparing reports,* including describing and illustrating work, substantiating procedures and findings, organizing the report, using appropriate style in presenting report.

6) *Administering research projects,* including selecting and training personnel, dealing with subordinates, planning and coordinating the work of groups, making administrative decisions, working with other groups.

7) *Accepting organizational responsibility,* including

[1] The opinions expressed in this article are those of the author and are not to be construed as reflecting the policies or opinions of the Navy Department.

[2] This study is reported in (1) *Critical Requirements for Research Personnel: A Study of Observed Behaviors in Research Laboratories.* American Institute for Research, Pittsburgh, Pa., March 1949; and (2) *Technical Appendices for Critical Requirements for Research Personnel.* American Institute for Research, Pittsburgh, Pa., March 1949.

performing own work, assisting in the work of others, subordinating personal interests, accepting regulations and supervision.

8) *Accepting personal responsibility*, including adapting to associates, adapting to job demands, meeting personal commitments, being fair and ethical, showing interest in work.

Factors correlated with creativity and productivity among research scientists. The general problem to be investigated, under Donald W. Taylor, Stanford University, is the determination of what abilities, motives, interests, traits of personality, childhood experiences, kinds of professional training, or academic achievements are related to originality or creativity, productivity, and general success among scientific men.

The general plan is to make an intensive study of a fairly large number of men actively engaged in research. Preliminary work is now underway in the Naval Electronics Laboratory. The investigation will be divided into three chief parts. The first part will be concerned with the development of criteria—i.e., of measures of originality or creativity, of productivity, of general success, and possibly of other characteristics. The second part will involve the use of a variety of methods, such as the biographical information blank, interviews, analysis of academic achievement, intelligence tests, interest inventories, civil service tests, recommendation forms, and personality evaluation. This study was started in April 1950.

Applications of the "Critical Requirements" Techniques

Four studies utilize the "critical requirements" developed through job analysis. It will be noted that this study of criteria has been used as a basic tool for all the studies in this section.

Development and refinement of criterion measures for evaluating performance of scientific work. This study, also under John C. Flanagan, has, in the main, been a field tryout of an Observational Record Form for Research Personnel. This form, based on the *Critical Requirements for Research Personnel* previously mentioned, is being used to record observations of *outstanding* and *unsatisfactory* job behaviors in research and development work, so that supervisors may be more effective in training, supervising, and evaluating their employees.

Three problems in connection with the use of this type of observational form are being studied, namely, the relative effectiveness of (*a*) a long versus short observational record, (*b*) comprehensive versus abbreviated training in the use of the form, and (*c*) daily, weekly, and monthly recording by the supervisor.

The study should provide an effective observational record form, instructional materials, including a manual, and a training program in the use of the form and manual.[3]

Development of selection instruments to measure aptitudes for scientific work. The selection of the beginning worker who will be productive in research and development depends in large part on determining whether the applicant possesses the aptitude for this function. It was desirable that a more effective instrument be available for identifying early in their career that very small percentage of professionally trained scientists and engineers who have talent for research and development. This study, under John C. Flanagan, undertook the development of an aptitude test applicable to the selection of junior professional workers in research laboratories.

This test then was developed as a measure of potentiality for, rather than proficiency in, research work. Further, the items were selected so that they could measure and be validated in terms of the critical requirements already established. This study has resulted in the development of a test of 170 items organized into three subtests.

The study has contributed to the theory of test construction by the development of a method of detailed hypotheses or "rationales" regarding the most suitable approach to the measurement of each of the critical requirements for research personnel. The aptitude test is now being tried out experimentally and, after further validation, will be offered for use in future civil service examinations, and for the use of universities in admitting students to graduate work in the physical and engineering sciences.[4]

Development of measures of proficiency in scientific work. This study, likewise under John C. Flanagan, is concerned with the development of test items for determining an applicant's proficiency in specific areas of scientific work. In contrast to the items in an aptitude test, these items are directed to the measurement of the technical background in a field of specialization.

This study, begun in February 1950, is at present concerned with the measurement of proficiency in critical job tasks, in the form of work samples and miniature job tasks, samples of necessary types of information, and measures of specific skills required.

[3] The instruments being used in this study are: (1) *Observational Record Form for Research Personnel.* American Institute for Research, Pittsburgh, Pa., June 1949. (2) *Manual for the Use of the Observational Record Form for Research Personnel.* American Institute for Research, Pittsburgh, Pa., June 1949.

[4] The techniques used in the study are reported in (1) *Development of a Test for Selecting Research Personnel.* American Institute for Research, Pittsburgh, Pa., January 1950. (2) *Technical Appendices for the Development of a Test for Selecting Research Personnel.* American Institute for Research, Pittsburgh, Pa., January 1950.

Recommendation blank to aid in the selection of scientific and technical personnel. In order to assess the qualifications of an applicant for a position, it is necessary to obtain a valid evaluation of his work performance or capabilities from his previous supervisors or teachers. The commonly used letters of recommendation have proved to be unsatisfactory. Therefore, this study, under Harold A. Edgerton, was undertaken to provide a technique or form that would give more valid evidence on the ability of applicants. Phrases descriptive of the performance or probable performance of research workers were compiled on a "more effective" and "less effective" basis. These phrases were supplemented by letters of recommendation from laboratory supervisors and university instructors.

Approximately 600 descriptive phrases were selected and organized into three lists, which were sent to some 400 heads of departments of physics, chemistry, and engineering in selected universities. On the basis of 250 completed returns, a sufficient number of phrases was secured to develop three forms. One of them was the conventional list of phrases, with the 1, 2, 3, 4, or 5 rating to be given on the applicable items. The other two were set up as "forced-choice." In the latter the phrases are grouped, on the basis of statistical values, into blocks composed of four to six phrases. The rater does not indicate how well or how poorly the applicant has performed, but rather in each block chooses one phrase as MOST DESCRIPTIVE and one phrase as LEAST DESCRIPTIVE. This means that the performance of the applicant is being described, which is more objective than "opinion." This technique then allows the one who receives the form to make an evaluation of the report on the applicant's performance.

An example of one block is:

Most	*Least*	
A	A	Never satisfied with superficial answers.
B	B	Easily breaks problems down into component parts.
C	C	Wants to be included in every activity and conversation.
D	D	Uses more complex equipment than necessary.
E	E	Does not push self or ideas.

Experience has shown there is some resistance to the use of this kind of form, partly because the respondent is not able to produce or predict a desired outcome. In addition, some object to the fact that the phrases in the block are not strictly related, as the example above shows.

These forms have been validated and are now being used experimentally in connection with civil service examinations.[5]

Other Productivity Studies

Several studies have been carried on to meet urgent problems before the basic investigations were under way or completed.

Selection of physical scientists. This study, under Willis Schaefer, was concerned with an analysis and validation of a test battery, which had been developed by the Test Development Unit of the U. S. Civil Service Commission. The Navy was directly concerned in that, in lieu of a separate examination for naval laboratories as in 1947 and 1948, it was decided to participate in the civil service nation-wide examination. Therefore, on invitation of the commission's Test Development Unit, this study was undertaken. The analyses and validation were based on 20 tests that had been administered to 826 chemists, physicists, and engineers in eight government installations. A variety of criteria was obtained, including supervisor rating, colleague ratings of performance, originality, research ability, etc., civil service grade, and age in grade. From this analysis, five tests appeared to be of most general usefulness, namely, surface development, mathematical formulation, hypotheses, subject matter (of the discipline), and biographical information blank. The first four of these were utilized in the 1949–50 "P-1" and "P-2" examination, which included a written test. The results of this test are being analyzed at present.

Study of candidates resulting from P-1 examinations. The Navy, along with other governmental agencies, industry, and the graduate schools, turns each year to the universities and colleges for candidates for the beginning grades of professional work. This study, under C. Thomas Clifton, was undertaken to discover the results of the Navy's recruiting and examining program in securing its proportionate share of the better and potentially more productive talent from recent graduating classes. The recruiting effort of one Board of U. S. Civil Service Examiners was examined to determine the "candidate caliber" resulting from its examining program. This analysis was based on 3,600 candidates for two nation-wide examinations conducted in 1947–48 and 1948–49. These candidates came from a potential population of 53,000 graduates in the scientific and engineering fields.

The "candidate caliber" was determined by an analysis within the partially overlapping groups of those who (1) applied for the examination, (2) took

[5] This study is reported in *Development of a Recommendation Blank to Aid in the Selection of Scientific and Technical Personnel.* Richardson, Bellows, Henry & Co., Inc., New York, June 1949.

the examination, (3) passed the examination, and (4) accepted or rejected offers of positions. This analysis made use of the candidates' civil service examination records and, where available, the candidates' college records.

The findings of the study showed (1) that there was definite improvement in the 1948 program over that of 1947, (2) that where recruiting teams composed of senior Navy scientists visit schools, more candidates are attracted, (3) that the examinations appear to select the better qualified (in terms of college grades or class rank), (4) that most appointees come from the upper half scholastically, but are of lesser quality than eligibles. The latter situation is due in part, at least, to the time lag in the steps of announcement, application, examination, eligibility, and offer of appointment. The findings of this study are being utilized by the board concerned in planning its current recruiting-examining program.

In-service training. The Navy, and also other research organizations, recruit young scientists who have completed only their undergraduate education, or perhaps limited graduate work. These men, if they are to be really productive, must receive further training, both "academic"—that is, in the subject matter of their disciplines—and on-the-job or in-service training, largely in terms of the needs of their immediate occupational specialty or position. An analysis of the "training" program of most laboratories shows that the program consists primarily of academic courses, most frequently of courses for university credit, even when offered within the laboratory. This is a necessary kind of training or education. Even senior scientists need to continue their study, with the ever-increasing rate of advance and specialization.

This study, under Douglas E. Scates, has been primarily limited to the development of techniques and instruments for determining in-service training needs. Six such instruments have been developed and evaluated through use in surveys of training needs at two different types of research and development installations—(*a*) a field installation, where 581 professional and subprofessional employees completed three questionnaires, and 261 were interviewed; and (*b*) a departmental bureau, where 261 professional employees completed a training need questionnaire, and 51 employees were interviewed.

Service reports on these surveys have been submitted to the installations concerned. The data obtained are now being analyzed, and a report will be prepared.

Methodology of research. Each year the government laboratories recruit a large number of college graduates in the physical sciences and engineering as junior staff members in research and development work. It is not to be expected that their undergraduate training could or should have given them any control or understanding of research methodology. However, this is needed, if these junior scientists are to be productive in research. While plans are being developed to undertake a full-scale attack on this problem, a listing of the offerings on methodology of research (as distinct from the philosophy or history of science) given in the catalogues of the some 90 American universities granting the doctorate in science, has been made, and preliminary analysis, under Alice V. Yeomans, of these courses is under way.

Future Plans

Within the general objective of this project, namely to derive criteria and to develop methods for evaluating, and increasing the productivity of scientific and engineering personnel, research on this problem will be continued. At present, either by continuing some of the subtasks mentioned above or by new subtasks, further work is planned on (*a*) identification of creativity in research workers, (*b*) the personal characteristics of research workers, (*c*) scientific and engineering functions, (*d*) the definition of occupational specialties, (*e*) motives that drive productive research and development workers, (*f*) morale factors and problems, and (*g*) personal attitudes and reactions.

From these studies it is expected that better tools for use in assessment of the capacities of potential workers and evaluation of the job performance will result, and methods and materials suitable for increasing the on-the-job productivity of workers will be developed.

Technical Papers

Phosphoglyceric Acid in Photosynthesis

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The role of phosphoglyceric acid as an intermediate in the photosynthetic reduction of carbon dioxide in plants has been the subject of conflicting claims. Calvin and Benson (*1*) reported that phosphoglyceric acid was the major radioactive compound formed in short-term photosynthesis with $C^{14}O_2$. Earlier work in our laboratory indicated that this compound was a minor component accounting for only a small percentage of the radioactivity fixed during 30–40 sec of photosynthesis (*2*). As a result of more recent experiments, done with higher CO_2 concentrations, we are now able to confirm the observation of Calvin and Benson. Since our identification was done by direct chemical methods different from those used by the California group, a somewhat detailed description seems in order.

Suspensions of the alga *Scenedesmus obliquus* were illuminated for 10–15 min in the presence of an excess of $C^{14}O_2$. After this period of normal photosynthesis, tracer (HCO_3^-) was added,[2] illumination was continued for 30–40 sec, and then the algae were killed in boiling water. The aqueous extract was combined with natural carrier material provided by the aqueous extract from about 2 pounds of nontagged algae. The solution was dialyzed, decationized on a column of Nalcite HCR, and exchanged onto a column of the weak anion exchange resin Amberlite IR4-B. The eluate obtained from the IR4-B with 1.5 *M* ammonia contained 80% of the total activity. This solution was concentrated, freed of ammonium ions by another cation exchange treatment, exchanged onto a column of 100–250 mesh Amberlite IR4-B, and fractionally eluted with 0.022 *M* ammonia. The center cuts from the activity peak of the eluate were concentrated and refluxed at pH 4.5 to hydrolyze phosphate esters. The material was again decationized, absorbed on Amberlite IR4-B, and fractionally eluted with 0.022 *M* ammonia. Center cuts from this activity peak were further purified by fractional elution from an intermediate-strength anion exchange resin, Ionac A-300,[3] with 1.0 *M* ammonia. The center cuts of the activity peak of the purified material were freed of excess ammonia, concentrated, extracted with ether to remove traces of nitrogenous compounds from the resin, and decationized. In each stage of the purification there was an appreciable increase in specific activity. The final purified material had a specific activity about 60 times that of the original hot-water extract.

From the solution of the purified glyceric acid, the barium salt, the *p*-phenylphenacyl, and the *p*-bromphenacyl esters were prepared. The esters were further purified by twofold chromatographic elutions from a silicic acid column with benzene containing 2.5% of acetone. Analyses of these compounds gave definite proof that the compound we had isolated was D-glyceric acid, formed by hydrolysis from D-phosphoglyceric acid. The compound apparently underwent partial racemization during the isolation. Table 1 gives the physical constants and analyses for the acid and derivatives.

TABLE 1

pK$_a$:
Reported for glyceric acid 3.55 (*3*)
Found for unknown acid 3.65 (by best fit of titration curve, uncorrected)

[α]$_D$:
Reported for Ba-D-glycerate, molybdate enhanced + 104° (*4*)
Found for Na salt, molybdate enhanced + 83°

Barium glycerate:[4]
Calculated Ba, 39.5%; C, 20.7%; H, 2.9%
Found (after vacuum drying at 110°): Ba, 40.0%; C, 20.6%; H, 3.1%

p-Phenylphenacyl glycerate:
Calculated C, 68.0%; H, 5.3%
Found: C, 67.6%, 68.0%; H, 5.2%, 5.3%

p-Bromphenacyl glycerate:
Calculated C, 43.5%; H, 3.6%; Br, 26.4%
Found: C, 43.5%; H, 3.5%; Br, 26.4%

Periodic acid oxidation of the *p*-phenylphenacyl ester showed the expected 1 mole of adjacent hydroxyls per mole of ester.

Because of the losses attendant upon selection of only the central portions of the activity peaks during purification, the purified esters accounted for only about 20% of the total activity in the hot-water extract. The determination of the total radioactivity in phosphoglyceric acid was performed with the help of artificial carrier. A known amount of phosphoglyceric acid was added to the algal extract, phosphate was hydrolyzed by incubation at 35° C with intestinal phosphatase (Armour Laboratories), the resultant glyceric acid was oxidized with periodic acid using the amount calculated for oxidation to glyoxylic acid and formaldehyde, and the carbonate-soluble 2,4-dinitrophenylhydrazone of glyoxylic acid was isolated and counted. These analyses showed that 50–60% of the activity fixed in 10 sec of normal photosynthesis was in phosphoglyceric acid.

[1] Atomic Energy Commission postdoctoral fellow in the physical sciences, the National Research Council.

[2] C^{14} was obtained as $BaCO_3$ from the Isotopes Division, U. S. Atomic Energy Commission.

[3] P. E. Holder, of the American Cyanamid Company, Chicago, kindly provided us with experimental quantities of fine-mesh Ionac A-300.

[4] The microanalyses were performed by William Saschek, Department of Chemistry, University of Chicago.

The total counts in the original extract were determined as $CaCO_3$ formed subsequent to wet combustion. Correspondence between these counts and the hydrazone counts was checked by wet combustion of several samples of the latter. The routine analyses on the total algal extracts were supplemented by an experiment in which phosphoglyceric acid, with carrier, was first eluted with 0.01 *M* hydrochloric acid as a narrow band from a 100–200 mesh column of Amberlite IRA-400 (Cl^-). This band was then subjected to the usual hydrolysis, oxidation, and isolation procedures. It accounted for 80% of the activity found in phosphoglyceric acid by analysis of the total extract. The discrepancy may be due to the presence of some tagged glyceric acid produced by phosphatase activity of the algae.

Our earlier results in which only 5% (15% in some later experiments) of the fixed tracer was found in phosphoglyceric acid may have been due to a deficit of CO_2 during the tagging. If this had been true, tracer would have been fixed first in phosphoglyceric acid and then rapidly transformed photochemically into other substances. In the more recent experiments leading to the isolation, a large excess of CO_2 was provided, so that a steady-state amount of phosphoglyceric acid typical of normal photosynthesis was always present. Further experiments on the kinetics of phosphoglyceric acid in photosynthesis have been reported elsewhere (*5*).

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A Study of Grinding Techniques for Bacterial Cells[1]

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It has long been a problem of the cell physiologist to get efficient grinding in the preparation of cell extracts. A recent study of this problem, using some of the common techniques and abrasives, yielded certain data that may prove useful. Three types of grinding equipment were used:

[1] Supported in part by a Hormel Institute Fellowship at the University of Minnesota, Austin, and submitted as a Master's thesis to the Department of Bacteriology and Immunology, University of Minnesota, Minneapolis.

1. An ordinary mortar and pestle of a capacity of 20–25 cc for trituration.

2. A Wood-Werkman mill (*1*), a mechanical arrangement whereby the mixture of organisms and abrasive is forced between 2 concentric conical ground-glass surfaces while the inner cone is rotated and the outer one is held stationary by a vicelike clamp. The rotating cone is hollow and can be filled with ice to provide refrigeration. A tube is fused on the small end of the outer cone in such a way as to form a funnel-like piece.

The pasty-fluid mixture of cells and abrasive is forced through the tube by means of a syringelike plunger, easily made by cutting down and ridging a rubber stopper. The mill is best used by first filling the hollow cone with cracked ice and closing the opening that fits over the drive shaft to avoid spilling the ice. The ice-filled cone is then placed in the funnel-like piece, and the grinding mixture poured into the open end of the tube. The plunger is inserted, and the stopper removed from the ice chamber. The assembled mill is then fitted to the clamping and driving mechanisms. A container is inserted under the lip of the funnel to collect the ground material. This can be cooled by means of an ice-water bath. By a slow, *steady* pressure on the plunger, the material is forced between the ground glass surfaces. At least ¼ hp electric motor should be used as a power source. Variable speed pulleys connect the motor to a gearbox, which drives the shaft that operates the mill. The variable-speed pulleys and gearbox allow adjustment of the speed from about 300 rpm to 600 rpm.

3. A modified Potter's homogenizer (*1*), which is constructed by grinding the inside of a pyrex glass tube and preparing a pestle with prongs on the end from another slightly smaller tube, to which a shaft is fused. The sides of the pestle are ground to a tolerance that permits the tube to slide off slowly when not supported. The modification is simple. The prongs are left off the pestle because the nature of the material to be ground does not require their presence. Two sizes proved suitable, but the longer tube and pestle is more satisfactory because it affords greater ease in handling, and the longer pestle presents a larger grinding surface. For grinding, the shaft of the pestle is best connected to a cone-drive laboratory stirring motor by means of a short piece of pressure tubing. This affords some flexibility, which helps prevent breakage of the homogenizer if the pestle should stick or get out of line. The speed of rotation is set at approximately 2,000 rpm. The speed is not constant because the drag of the pestle in the grinding mixture slows it down considerably, and it varies with the adhesiveness of different abrasives. For refrigeration the homogenizer tube is placed in a suitable container filled with cracked ice and water. The two are then moved simultaneously up and down, grinding the cells by forcing the rotating pestle through the mixture.

Commercial abrasives used were Norton's Abrasive Grain Alundum 600X, Norton's Levigated Alumina, Johns-Manville Hyflo Super-Cel, and silicon carbide 940X, which may be obtained from any optical company. Hyflo Super-Cel can be used as it is received, except that it

must be washed thoroughly with distilled water. Glass or flint used as the abrasive was prepared by sieving the material through an ordinary kitchen strainer and placing approximately 500 g of this in a 1-gal size ball mill. The ball mill was allowed to run for a period of 200 hr. The abrasive was then harvested by simple liquid levigation. Three-fourths of a gal of distilled water was used to wash the powdered abrasive out of the ball mill. The powder was thoroughly mixed with the water and allowed to settle for varying periods of time, depending on what particle size was desired. It was found that the particles remaining in suspension after 20 hr of settling were of a size suitable for the grinding of bacterial cells. The average particle size was 1.25 μ.

This levigation technique is satisfactory for the preparation of most abrasives, and the resulting fractions are quite uniform in size. The time element for settling varies somewhat with the nature of the abrasive; for example, pyrex glass settles out somewhat more slowly than flint. Increase in the ratio of water to powdered abrasive will give more uniformity in size of the settling particles.

Escherichia coli was used as the test organism for this study. The cells were grown in 4 l of 1% lactose broth equally divided into six 2-l flasks, which were placed on a shaking machine for a 24-hr incubation period. They were harvested by centrifugation. The efficiency of the grinding techniques was evaluated as per cent kill by making viable counts before and after grinding.

A series of experiments was conducted using various proportions of cells, abrasive, and water in an effort to establish a suitable set of conditions permitting a grinding efficiency of 99% or better, which could be duplicated in most, if not all, laboratories at a minimal expense with regard to the special equipment required. The mixtures are conveniently made up with an ordinary pan balance or triple beam laboratory balance. The significant data are summarized and recorded in Table 1.

Ratio of cells to abrasive is not as important as the ratio of cells plus abrasive to water. Ratios of cells to abrasive and water content of the grinding mixture vary with the nature of the abrasive and the technique to be used. A ratio of cells to abrasive of 1:2 or 1:1, with proper water content to hold the viscosity to the state of a creamy paste, gives high grinding efficiencies with several abrasives. The Potter's homogenizer requires a less viscous mixture than the other two methods used. It is important that the moisture content of the mixture for grinding be kept below the critical level. If the fluid content is too high it appears to act as a mechanical buffer, because the efficiency falls off markedly.

The lethal effect of the various abrasives from contact alone was checked, and the following results noted. The alumina abrasives showed no marked evidence of lethal effect. The pyrex glass and flint showed no noticeable lethal effect, but the data clearly demonstrated the difficulty of redispersing and making a homogeneous mixture with the bacterial cells. The unwashed Hyflo Super-Cel had a marked lethal effect, but on washing with distilled water three times it gave experimental evidence of no lethal effect. Silicon carbide may be suitable if it does not harm the system being studied.

The idea that glass is the best abrasive to use for

TABLE 1

Method of grinding	Ratio of cells to abrasive	Ratio of H_2O to abrasive	Time ground (min)	Kill (%)	Abrasive used
Hand grinding	1:2	1:2	5	46.3	Norton's 600 × alundum
			20	59.1	
	1:4	1:2	5	59.1	
			20	90.6	
Potter's homogenizer	1:2	3:5	5	95.3	
			20	99.3	
	1:4	3:5	5	93.2	
			20	99.2	
	1:8	23:40	5	93.3	
			20	99.7	
Wood-Werkman mill	1:2	1:2	1*	82.6	
			3*	94.3	
	1:4	11:20	1*	80.9	
			3*	91.8	
	1:8	11:20	1*	83.0	
			3*	96.3	
Potter's homogenizer	1:4	1:4	10	98.9	Silicon carbide 940 ×
Wood-Werkman mill	1:8	1:4	1*	99.6	
Potter's homogenizer	1:4	3:10	5	97.0	Norton's levigated alumina
			10	99.7	
			20	99.9	
Wood-Werkman mill	1:4	3:10	1*	83.0	
			2*	89.4	
			3*	99.7	
Potter's homogenizer	1:4	3:5	5	63.4	Pyrex glass (1–3μ)
			15	73.5	
Wood-Werkman mill	1:4	1:2	1*	90.0	
			2*	88.0	
	1:4	3:5	1*	66.7	Flint (0.7–1.2μ)
			2*	74.2	
Potter's homogenizer	1:2	1:2	10	98.8	Norton's levigated alumina
			20	99.4	
	1:1	1:1	10	37.7	
			20	56.9	
	1:1	1:2	20	99.6	
	1:1	7:10	20	77.8	Pyrex glass (0.6–1μ)
	1:2	3:1	15	99.9†	Hyflo Super-Cel
	—	—	40	42.0	None

* Instead of time in min, the material was put through the mill once, twice, or three times.

† Hyflo Super-Cel consistently gave results of 99.9% kill with 15 min grinding time.

grinding bacteria is not necessarily correct. If there is justification for using glass abrasives, it is because the adsorption of cellular material to the surface is less with glass than with other abrasives. However, Hyflo Super-Cel is believed to be quite free of adsorptive properties (*2*) and is easily prepared for use as an abrasive; it would thus seem more desirable than glass. Hyflo Super-Cel gives grinding efficiencies of 99.9% with 1 part cells, 2 parts abrasive, and 6 parts water.

Efficiency of grinding bacterial cells is chiefly dependent on the total abrasive action applied to the cells. In general, all techniques tried tended to support this concept. Evidence for this is exhibited by the higher efficiency of long grinding periods over short grinding periods. Additional evidence is the fact that the Wood-Werkman mill supplies more abrasive action than the Potter's homogenizer when pyrex glass is used as an abrasive. This is due to the gearbox and more powerful motor on the Wood-Werkman mill setup, which overcomes the friction of the glass paste more readily than the smaller motor on the homogenizer. When grinding large volumes of material and/or when using glass as the abrasive, the Wood-Werkman mill is more advantageous.

The two hardest abrasives tried, flint and pyrex glass, are not as efficient as the others, probably because of the coefficients of friction, as well as the character of the particle surfaces, and are more difficult to prepare. Levigated alumina as an abrasive gives efficiencies of 99% or better, with no lethal effect on prolonged contact with the cells in mixtures of these proportions:

a) 2 parts cells, 2 parts abrasive, and 1 part water
b) 1 part cells, 2 parts abrasive, and 1 part water
c) 5 parts cells, 20 parts abrasive, and 6 parts water

On the basis of viable cell counts, the Potter's homogenizer is an efficient grinding method to use for bacterial cells and possesses a capacity that yields adequate amounts of preparations for most experiments. It does not necessarily follow, however, that the resulting cell-free extracts will have high enzyme activity. The advantages over the Wood-Werkman mill are:

a) It requires less special equipment and storage space in the laboratory.
b) The initial cost of the material is a fraction of the cost of the Wood-Werkman mill setup.
c) It is more versatile and can be used with greater facility.
d) It is easier to refrigerate.
e) Sterile technique can be more easily applied.
f) Less material is lost in grinding, and smaller amounts can be used with satisfying results.
g) It offers easy modification to grind under anaerobic conditions simply by attaching a jet tube and flooding the upper portion of the tube with the desired inert gas.
h) High grinding efficiency can be obtained in less time.
i) Cell destruction can be obtained without addition of abrasive material.

The final trial of grinding without an abrasive in the Potter's homogenizer compared very favorably with the efficiency of the Booth-Green mill (*3*), which gives a 50% kill in 2 hr without refrigeration. The utility of grinding without an abrasive is questionable because of the long time required and the relatively low efficiency.

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The Fluorine Content of Some Miocene Horse Bones

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In view of the recent successful application of fluorine analysis in determining the relative ages of various human and animal remains from the well-known Galley Hill and Piltdown sites, it occurred to the author that this method might advantageously be extended to fossil bones from still earlier horizons. The following paragraphs present a few such data obtained through analysis of Lower Miocene horse material from the Raeford Thomas farm, Gilchrist County, Florida.[1]

Inquiry into the fluorine content of both recent and fossil bone dates back at least to the beginning of the 19th century. The French mining engineer A. Carnot (*2*) has furnished an interesting account of these early procedures and determinations. In order to make their work quantitative, however, pioneers in this field were under the necessity of employing rather lengthy and tedious routines. The modern technique, a modification of which was applied to the British specimens, was published in 1933 by Willard and Winter (*3*). The method is both sensitive and specific. It is typical of the growing tendency to employ organic agents in the determination of inorganic ions. It has, moreover, the advantage, often inestimable to the anthropologist or paleontologist, of requiring only small amounts of tooth or bone, the analysis of which by ordinary gravimetric methods would entail a high percentage of error. In every essential it is the method that has been followed in the present analysis of horse remains.

Since the value of the test for this purpose depends upon its indication of relative, rather than absolute, amounts of fluorine, every effort was made to follow precisely the same routine in each trial of every sample and thus to secure consistent results. The bones were first

[1] Permission to examine these fossils was kindly accorded by A. S. Romer, director of the Museum of Comparative Zoology. The author also wishes to thank Arthur Loveridge, of the same institution, for calling his attention to the article by Kenneth P. Oakley on "Relative Dating of the Piltdown Skull" (*1*).

TABLE 1

FLUORINE ANALYSIS OF LOWER MIOCENE HORSE BONES

Sample No.	Description	No. titrations	Fluorine, %
1	large, light, unworn	3	2.4
2	" dark, "	3	1.7
3	small, light, "	3	2.6
4	" dark, "	3	1.9
5	large, light, worn	3	1.5
5a	" " "	1	1.5
6	" dark, "	4	1.7
7	small, light, "	5	2.7
8	" dark, "	3	1.7
9	large, light, "	1	1.9
10	" " "	1	1.9
11	recent	3	< 0.01

pulverized, and the material well mixed to ensure proper sampling of both dense and spongy tissue. To promote accuracy, the comparatively large amount of 1 g was used in each distillation. The latter was carried out with a measured volume of 60% perchloric acid under prescribed conditions of temperature and in the presence of soft glass (source of silica), the volume of each distillate being carefully noted. Aliquots of each were titrated with .10% solution of thorium nitrate, a fixed amount of the zirconium-alizarin indicator being used for each titration. It is necessary to make a small correction for the fluorine that combines with alizarin. The agreement between fluorine values calculated from successive titrations of distillate from a given bone was unexpectedly close. Average values only are reported in Table 1. They give the percentage weight of fluorine in the fossil. A necessary preliminary, of course, is to establish a working curve by titrating standards of known fluorine content (as fluoride) with thorium nitrate. Because none of these specimens was sensibly contaminated with matrix, the additional determination of phosphate has been omitted.

Briefly, the fossil bone quarry from which these Lower Miocene specimens were collected has yielded a large number of disarticulated elements, belonging, for the most part, to what has been described by T. E. White as a monophyletic series, *Parahippus blackbergi—P. barbouri—P. leonensis—Merychippus gunteri* (*4*). These bones appear to have been deposited in the channel of a stream, and some are plainly water-worn. The time interval is that represented by most of the Tampa and the lower part of the Hawthorne formation.

A study of their size relations (*5*) shows very clearly how these elements, kind for kind, sort into two size groups, the large and the small, the latter being less numerous. From the standpoint of preservation, they may again be separated as light in color or dark, worn or unworn. The skeletal unit chosen for analysis was the first phalanx (*os suffraginis*) of the principal digit, and the fluorine values listed for each of the descriptive categories in Table 1 refer to this bone alone.

It will be observed that the values fall into two groups: an upper, averaging 2.6%, and a lower averaging 1.7%. Their difference approximates the order of 1%, the total range being less than 1½ parts per hundred. The fluorine content is also seen to be independent of size. Although extreme values are found for light-colored bone, the dark furnishing low figures only, the data are considered insufficient to establish any correlation with iron content. In the case of the Piltdown and other British materials, this correlation was reported as inappreciable (*1*).[3] Most significant of all, perhaps, is the circumstance that both low and high values occur irrespectively in worn and unworn bone.

For the sake of comparison, a figure is included in the table for the fluorine content of recent bone. The element is reported present in human bone in amounts ranging from 0.01 to 0.03%. The author's analysis of an ashed sample from the first phalanx of *E. caballus* yielded a value less than 0.01%. These figures at least serve to emphasize one specific difference between recent and fossil bone.

Under circumstances where the principle of fluorine-dating would apply, so marked a difference between these groups of values might properly be taken to indicate two origins in time. However, the above-stated and well-attested time interval (Tampa-Hawthorne) is insufficient to account for the observed difference in fluorine accumulation. Alternatively, we may conclude that these bones have lain for long periods in distinct areas, perhaps not widely separate, but certainly percolated by ground waters of quite different fluorine content. Finally, the distribution of values in both worn and unworn bone suggests that such signs of wear as smoothed surfaces, rounded contours, etc., are neither exclusive nor quite reliable indications of transport.

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An Apparatus for the Simultaneous Production of Many Two-dimensional Paper Chromatograms

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Frequently in clinical laboratories or in the course of physiological, biochemical, or nutritional experiments it is an advantage to be able to run rapidly a large number of two-dimensional chromatograms of several specimens at

[1] Foulerton Research Fellow.
[2] In receipt of a grant from The Medical Research Council.
[3] We wish to thank A. Munday and T. Alexander for the diagram and photographs.

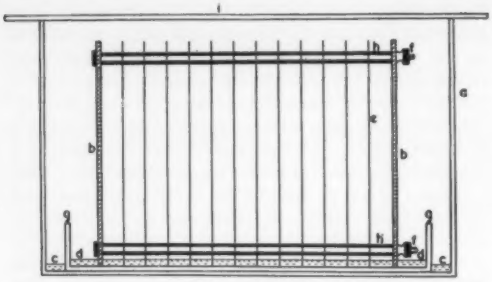

FIG. 1. Diagram of lateral view of apparatus. *a*, Tank, or box; *b*, end plates of frame; *c*, water; *d*, solvent mixture; *e*, paper; *f*, knurled nuts; *g*, dish; *h*, collar; *i*, glass lid.

the same time and under the same conditions. Using the large sheets of filter paper (18 in. × 22 in. or 30 in. × 30 in.) as described by Consden, Gordon, and Martin (*1*) and Dent (*2*), a great deal of space and equipment is necessary if one wishes to run more than 3 or 4 chromatograms daily, and the expense of solvents becomes serious.

We have found that a reasonable resolution of some 15 amino acids may be obtained on papers 20 cm square, using phenol and collidine-lutidine as solvents. The resolution is certainly adequate for the routine examination of urines, plasma ultrafiltrates, and cerebrospinal fluids. Twelve papers of this size are mounted parallel on a frame and are allowed to stand in a dish containing the first solvent, the whole being enclosed in a suitable box, or tank. The solvent creeps upward in the paper, and, when it has reached the top, the frame and papers are removed, dried, and placed in the second solvent so that it will travel in a direction at right angles to the first. The papers are then dried again, removed from the frame, and the spots developed visibly with ninhydrin in the usual way.

The frame (Fig. 1) consists of 2 duralumin plates 20 cm square and .3 cm thick; one plate is drilled and tapped with a 2BA thread in each corner, the centers of the holes being 1.5 cm from each edge of the plate. The second plate is drilled in line with the first with holes which will just clear a 2BA thread (4.8 mm). Into the holes in the first plate are screwed duralumin rods 28.2 cm long and .63 cm in diameter. These rods are threaded with a 2BA thread for .6 cm at the end, which is screwed into the plate, and for 1.6 cm at the other end; thus there are left 26 cm of unthreaded rod. These rods are fixed to the plate with knurled duralumin lock nuts .3 cm thick. The threaded part of the free ends of the rods passes through the holes in the second plate; these holes are not large enough to pass over the main part of the rod, and the plate may be fixed by knurled lock nuts 1.2 cm deep.

On each rod are 13 duralumin collars 2 cm long, 1 cm outside diameter, and .67 cm internal diameter. These slide easily on the rods and allow the papers to be kept apart. It is important that the collars fit loosely on the rods; otherwise, they will jam when the solvent is dried out.

The dish may be of duralumin, acid-resisting enamel, or porcelain. We have found that photographic developing dishes 35 cm × 28 cm are suitable, provided they have flat bottoms. The tank consists of an angle-iron framed glass aquarium 32 × 40 × 25 cm internal dimensions, covered with a well-fitting sheet of glass.

We have used both Whatman No. 1 and No. 4 filter papers, which may be obtained from the manufacturers in 20-cm squares. A hole is made in each corner of the paper to thread over the rods of the frame. A duralumin plate the same size as the end plates of the frame, with holes drilled in line, is used as a template in boring the holes. The holes in the template are large enough to pass a cork borer or other punch that will make a hole in the paper about .5 cm in diameter; this allows the paper to be a tight fit on the rods and to be held tightly stretched between them. With a template and a sharp cork borer it is possible to cut holes in 12 papers at a time. It is of great importance to align the papers correctly for boring so that when threaded on the frame their edges are parallel to and at the same level as those of the end plates. In this way a solvent front which travels parallel to the edge of the paper can be ensured.

We have used phenol (4 parts phenol, 1 part water) and collidine-lutidine (1 part each of collidine, lutidine, and water). These mixtures form one-phase systems with much less sensitivity to temperature changes than the mixtures usually described. Water is placed in the tank outside the solvent dish. These solvents do not corrode duralumin, nor does the metal appear to have any deleterious effect on the solvents or amino acids. No doubt other solvents could be used, but the resistance of the frame to corrosion by them should first be tested.

The mixture to be analyzed is applied in one corner of a paper at a point 3 cm from each edge, the spot being down to about 1 cm in diameter. We have found 5–25 μl urine, 50–125 μl plasma ultrafiltrate, and 625 μl cerebrospinal fluid to be satisfactory amounts in most cases. The papers are then threaded onto the frame, care being taken that the areas of paper to which the mixtures have been applied are all together at the same corner of the frame. Up to 12 papers may be put on the frame, each paper being separated from the next one, or the end plate, by a 2-cm collar on each rod. When less than 12 papers are being run, more than one collar may be used to separate them; in any case, the full number of 13 collars must be used on each rod so that there is no possibility of the papers moving or touching (Fig. 2).

The frame is then placed in the dish containing the first solvent (phenol), with the appropriate edge downward. The amount of solvent must be sufficient to allow all the papers to be completely wetted during the run and, at the same time, not so much that the area of paper holding the mixture to be analyzed is at all immersed in it. A few drops of ammonia are added to the water in the tank to keep the atmosphere alkaline. The lid is then put on.

When the solvent has reached the top of the papers, the frame is removed from the tank and placed in a stream of air to dry out the papers. When dry the frame is placed in the second solvent (collidine-lutidine) in another tank. Again the frame should be so placed that the solvent passes at once through the line of amino acids

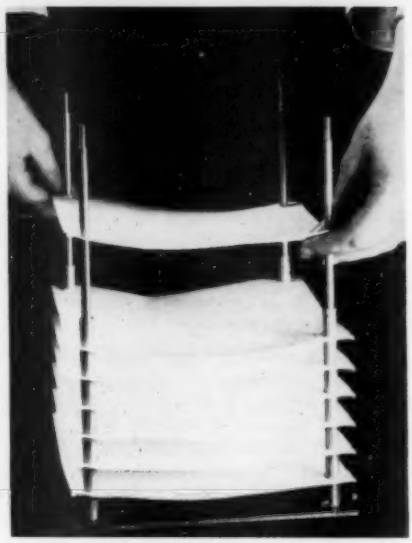

FIG. 2. Method of loading papers on frame.

formed during the phenol run and carries them along at right angles to their previous direction of movement.

When the collidine-lutidine solvent front reaches the top of the paper, there will be a brown line 3–4 cm behind it. No amino acids move in front of this brown line, and in order to increase their resolution in this solvent it may be made to overrun the chromatograms by laying sheets of filter paper horizontally in contact with their uppermost edges. These extra sheets of paper are held in place with thin sheets of glass, thus ensuring good contact. The run should be continued until the brown line almost reaches the top of the chromatograms.

When the second solvent has completed its travel, the frame is removed from the tank and the papers dried in a stream of air. They are then taken out of the frame, sprayed with ninhydrin, and developed by heating in the usual manner.

Using Whatman No. 1 paper, the run takes about 8 hr at 22° C in each direction. The frames may be put in the tanks at night and removed in the morning. Allowing the papers to stand in the tank for a few hours after the run is completed does not lead to any diminution in resolution. They may be dried during the day, and the second run carried out the next night. With 2 frames and 2 tanks it is possible to have 12 chromatograms completed each day, though the result of a particular test cannot be obtained for 48 hr. With Whatman No. 4 paper at 22° C, the run takes about 4 hr in each direction; thus a chromatogram may be completed in one day.

We have used this technique successfully for routine survey of large numbers of urines such as may be required in clinical work, for genetical investigations involving the analysis of urines of many members of the same family, and for physiological experiments involving the sampling of biological fluids over long periods of time. It would also be readily adaptable to semiquantitative work by running serial dilutions of the material to be studied, together with several dilutions of standard solutions on the same frame. Furthermore, there is no reason why the frame should not be lengthened considerably so that many more chromatograms may be run simultaneously.

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Self-Absorption and Backscattering of β Radiation[1]

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The complex nature of the absorption and scattering of β particles causes many difficulties in β counting, especially with low-energy β emitters such as C^{14}, S^{35}, and Ca^{45}, which are much used in biological work. It is often necessary to count sources of appreciable thickness for which self-absorption of the β radiation is significant. A further effect to be considered in the counting of thin sources is the backscattering of β radiations by the container or backing material used to support the source. This effect is strongly dependent on the atomic number (Z) of the backscatterer and is large for materials of high Z. Sources are often made "infinitely thick" for self-absorption, i.e., of thickness at least equal to the range of the β radiation, in order to avoid the large self-absorption corrections required for sources of intermediate thickness. However, for this case (as for any thickness greater than about 5% of the range of the β radiation) the effect of self-scattering (internal scattering) by the source must also be considered. From the experiments reported here it was found that self-scattering by the source increases with the average atomic number of the source material, as in the case of backscattering by the source holder.

An investigation of the above-mentioned effects was carried out with S^{35}, Ca^{45}, and P^{32} obtained from Oak Ridge. These nuclides are simple β emitters with maximum energies of 0.17 mev, 0.26 mev, and 1.7 mev, respectively. Counting was done with a Tracerlab end-window counter with window thickness of 1.5 mg/cm² and diameter of 2.8 cm. The counter was attached to a slotted aluminum shelf holder, which permitted counting of sources at various distances from the counter. The whole counter assembly was housed in an aluminum-lined lead shield. The coincidence loss correction for the counter was 0.6%/1,000 cpm.

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Circular flanged dishes stamped out of aluminum, steel, copper, cadmium, and lead were used as source holders. The dishes were 2.8 cm² in area and 0.5 cm in depth. Their thickness (0.045 cm) was sufficient to provide saturation backscattering for all sources, as shown by the failure of additional backing (placed against the underside) to increase the counting rate of the source. The dishes were supported by an aluminum shelf with a hole cut out of the center.

The vertical distance between the source and the counter window was 0.8 cm in the shelf 1 position and 2.0 cm in the shelf 2 position, corresponding to calculated geometry factors of 25% and 9%, respectively. The geometry factor determined for shelf 1 by counting a weighed source (5 mg) of U_3O_8 spread over an area of 2.8 cm² on a thin collodion film ($\sim 20\ \mu g/cm^2$) was 19%, a value somewhat lower than the calculated value, as would be expected for an extended source.

Self-absorption. The self-absorption of β radiation may be shown (*1, 2*) to follow the equation

$$\frac{A_d}{A_o} = \frac{1 - e^{-\mu d}}{\mu d}, \qquad (1)$$

where A_o is the activity (counting rate) of a given amount of the radioactive nuclide with no self-absorption, A_d is the activity of an equal amount of the radioactive nuclide contained in source material of thickness d in mg/cm², and μ is the absorption coefficient in cm²/mg. This equation is based on the assumption that β radiation is absorbed exponentially, which is only approximately true (*3*). Nevertheless, the agreement between equation (1) and self-absorption curves obtained experimentally is remarkably good.

In the present investigation self-absorption curves were obtained by two different methods. The method first used consisted of precipitating constant amounts of the radioactive nuclide with increasing weights of source material, transferring the precipitates to dishes, and counting. After a few preliminary experiments this method was abandoned in favor of another method that gave essentially the same results but was decidedly more convenient. In the latter procedure a supply of source material was prepared that contained a known quantity of the radioactive nuclide. Various weights (thicknesses) of this material were then counted, and the counting rate of each source was divided by the weight of the source to give the specific activity (cpm/mg). A plot of specific activity versus source thickness gives the desired self-absorption curve. In order to obtain uniform and complete distribution of the thinner sources (< 10 mg/cm²) over the surfaces of the dishes, it was found necessary to slurry the source material in a little acetone, stir thoroughly, and evaporate to dryness. For thicker sources, good results were achieved by simply spreading the source material in the dish and tamping lightly with the flat end of a metal cylinder until the source was smooth and uniform.

The self-absorption of the β radiation of Ca^{45} in $CaCO_3$ is shown in Fig. 1, where the observed specific activity is plotted against source thickness. The data are seen to be well fitted by the curve of equation (1) with a value of 0.09 cm²/mg for the absorption coefficient, μ. The data in Fig. 1 were obtained with copper dishes in the shelf 1 position. Several other curves obtained with aluminum and steel dishes in both shelf positions gave values for μ in the range 0.09 ± 0.01 cm²/mg. The point plotted at zero thickness in Fig. 1 is the counting rate of an aliquot of the Ca^{45} stock solution evaporated in a copper dish. This source was essentially weightless (< 0.1 mg) but contained the same amount of Ca^{45} as represented by the other points on the curve. It will be noticed that the activity of the weightless source is somewhat greater than that given by extrapolation of the curve. With aluminum dishes, however, the activity of the weightless source was found to be a little less than that obtained by extrapolation of the curve. This effect is due to backscattering by the dish and was investigated more carefully in the experiments with S^{35} discussed below.

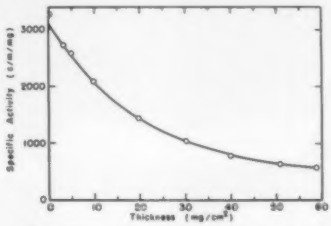

FIG. 1. Self-absorption of Ca^{45} β radiation in $CaCO_3$.

The self-absorption of the β radiation of S^{35} in benzidine sulfate is shown in Fig. 2. The points plotted as squares represent the self-absorption observed with aluminum source holders (dishes). The data obtained with beryllium source holders are plotted as circles. The beryllium source holders were prepared by removing the bottoms from aluminum dishes and replacing with beryllium plates. The important feature of Fig. 2 is the difference in the initial slopes of the self-absorption curves caused by backscattering of the β radiation from the source holders. The relative backscattering by beryllium ($Z = 4$) and aluminum ($Z = 13$) is indicated by the points at zero source thickness, which represent the counting rates of identical weightless sources of S^{35} evaporated on the two metals. It is seen that the specific activities of the sources of thickness less than about

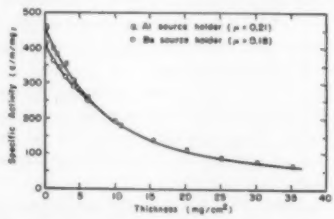

FIG. 2. Self-absorption of S^{35} β radiation in benzidine sulfate using source holders of different atomic number.

6 mg/cm² mounted on aluminum are higher than the activities of similar sources on beryllium because of the greater backscattering by aluminum. For thicker sources, in experiments with both S^{35} and C^{14}, the source holder has no effect on the self-absorption curve.

It should also be mentioned that self-absorption curves obtained with $CaSO_4$, $BaSO_4$, and $PbSO_4$ for thicknesses greater than 10 mg/cm² were identical in shape with the curve of Fig. 2, but gave greater specific activities because of increased self-scattering by the source materials of higher atomic number. This effect was observed in the self-absorption of C^{14} in wax and $BaCO_3$ by Yankwich and Weigl (*4*), who also found that differences in self-scattering affect the initial slope of the self-absorption curve. From the data in Fig. 2, an absorption coefficient of 0.18 cm²/mg is obtained for sources of all thicknesses mounted on beryllium. With aluminum source holders, however, the absorption coefficient is initially 0.21 because of the backscattering effect.

Henriques *et al.* (*1*) obtained an absorption coefficient of 0.265 for benzidine sulfate mounted on filter paper. For $BaSO_4$ mounted on lusteroid an absorption coefficient of 0.216 was obtained by Larson *et al.* (*4*). In view of the discrepancies among the various values found for the absorption coefficient and the above-mentioned effects of scattering by source holders and source materials, it would seem advisable for each investigator to obtain a self-absorption curve under the particular experimental conditions being used if accuracy is desired.

Backscattering and self-scattering. In earlier studies of β-counting problems by Engelkemeir *et al.* (*6*), it was shown that sources of identical intensity may exhibit markedly different counting rates, depending on the thickness and atomic number of the source support and on the thickness of source material, as a result of scattering of the β radiation. In the case of backscattering by the support, the counting rate of a weightless or very thin source is observed to increase with increasing thickness of the support (due to reflection of β particles into the counter) to a point beyond which there is no further increase. The source is then considered to have saturation backscattering. This point is generally reached at a thickness equal to about 20% of the range of the β radiation. The increase in counting rate at saturation backscattering is also found to be a function of the atomic number of the source support, the backscattering effect increasing with increasing atomic number. In the case of self-scattering, the observed counting rate of a given activity is found to increase when the activity is incorporated in increasing thicknesses of source material. Beyond a certain thickness, of course, the counting rate decreases because of self-absorption. The self-scattering effect generally reaches a maximum (saturation) at a source thickness equal to 5–10% of the range of the β radiation. Further studies of backscattering have been made by Zumwalt (*7*) and Burtt (*8*) in connection with problems of absolute β counting.

In the present investigation of saturation backscattering and self-scattering effects, the β radiations of S^{35} and P^{32} were employed. In the backscattering experiments identical aliquots of a stock solution of the nuclide were evaporated on various source holders to give essentially weightless sources. Source holders with no backscattering were prepared by removing the bottoms from aluminum dishes and replacing them with thin collodion films of ~ 20 μg/cm² thickness, which provide negligible backscattering. Sources with saturation backscattering were prepared both by evaporation of the active solution directly on the various metal dishes and by placing metal backings beneath (and just in contact with) a collodion film on which the active solution had been evaporated.

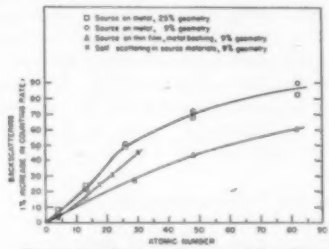
Source on metal, 25% geometry
Source on metal, 9% geometry
Source on thin film, metal backing, 9% geometry
Self scattering in source materials, 9% geometry
BACKSCATTERING (% INCREASE IN COUNTING RATE)
ATOMIC NUMBER

FIG. 3. Saturation backscattering and self-scattering of S^{35} β radiation as a function of atomic number of the scatterer.

The variation of saturation backscattering with atomic number of the source holder for S^{35} is shown in Fig. 3. The backscattering effect is plotted as the percent increase in counting rate over the counting rate of the source mounted on a collodion film, which is considered to have zero backscattering. For sources evaporated directly on metal, the backscattering effect was determined in both shelf positions with essentially the same results. The backscattering for sources on metals is considerably greater than that for sources on films with metal backings. This remarkable effect was first observed by Yaffe (*9*). The most reasonable explanation for the effect is that the relatively irregular surface of a metal provides more opportunity for small angle scattering of β particles in the direction of the counter than does the smooth surface of a plastic film.

Also shown in Fig. 3 are the data on the self-scattering of the radiation of S^{35} as a function of the average atomic number of the source material. In this experiment, thick sources (30 mg/cm²) of benzidine sulfate (average $Z = 4.5$), $BaSO_4$ (average $Z = 17.3$), $PbSO_4$ (average $Z = 21.7$), and Hg_2SO_4 (average $Z = 29.7$) were prepared to contain the same quantity of S^{35} as used in the sources prepared for the backscattering experiment. The observed counting rates of the thick sources were corrected to zero self-absorption, using an absorption coefficient of 0.18 cm²/mg (Fig. 2), and compared with the counting rate of the weightless source mounted on collodion film. It is seen that the counting rate of a source is not independent of the composition of the source material, as is often assumed, but increases with increasing average atomic number of the source material in consequence of increased self-scattering.

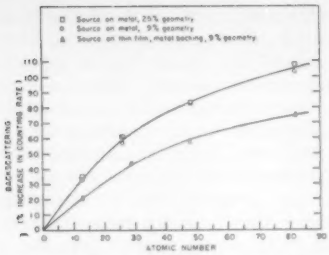
Source on metal, 25% geometry
Source on metal, 9% geometry
Source on thin film, metal backing, 9% geometry
BACKSCATTERING (% INCREASE IN COUNTING RATE)
ATOMIC NUMBER

FIG. 4. Saturation backscattering of P^{32} β radiation as a function of atomic number of the backscatterer.

The backscattering data for P^{32} are shown in Fig. 4; the effect is again found to be the same for the two shelf positions, and greater for sources on metals than for sources on films with metal backings. The data for the latter type of source mounting are in reasonable agreement with the data for P^{32} given by Engelkemeir (*6*), Zumwalt (*7*), and Burtt (*8*), who used only this mounting procedure.

It is also seen from a comparison of Figs. 3 and 4 that the backscattering of the high-energy β radiation of P^{32} (1.7 mev) is apparently greater than that of the low-energy β radiation of S^{35} (0.17 mev) for a given atomic number, and that there is a noticeable dip in the curve

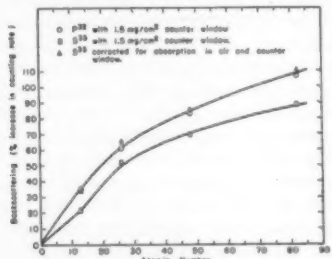

FIG. 5. Saturation backscattering for P^{32} and S^{35} with absorption corrections applied to S^{35}.

for S^{35} on metal at low atomic number. These differences were found, however, to be due entirely to absorption of the backscattered β radiation of S^{35} in the air gap and counter window.

Absorption curves were obtained with thin aluminum foils for the S^{35} sources (in the shelf 1 position) evaporated on film, aluminum, steel, cadmium, and lead. From the first absorption curve the initial half-thickness of the primary radiation from the film was observed to be 2.5 mg/cm². By subtraction of this curve from the rest of the absorption curves, the initial half-thickness of the radiations backscattered by aluminum, steel, cadmium, and lead were found to be 1.3, 1.7, 1.7, and 1.7 mg/cm², respectively. The lower value for aluminum is probably responsible for the dip observed in the backscattering curve and indicates that β radiation is more degraded in energy by scattering from materials of low Z than by scattering from materials of high Z.

Using the above absorption data, the backscattering results for S^{35} were corrected for absorption of the β radiation in the air gap and counter window. The results are shown in Fig. 5, where the squares and triangles represent the uncorrected and corrected data, respectively. The circles represent the data for P^{32}, which require no correction for absorption because of the high energy of P^{32} β radiation. It is seen that the corrected backscattering of S^{35} is in good agreement with that of P^{32}, indicating that the backscattering of β radiation for a given atomic number is independent of the β energy, at least over the range of energy from 0.17 to 1.7 mev. This is in agreement with Zumwalt (*7*) and Burtt (*8*), who have reported the same result for the range of energy from 0.3 to 1.7 mev.

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The Pungency Taste Characteristics of Some Piperazine Derivatives

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Staudinger and Schneider (*1*) found that the piperidides of β-cinnamenyl acrylic acid, 5-phenyl-2-pentenoic acid, 5-phenyl-3-pentenoic acid, and 5-phenyl-π-valeric acid have the same pungent taste characteristics of the piperine of black pepper, *Piper nigrum*. Riccomanni (*2*) reported that the piperidine nucleus could be substituted by piperazine and stated that the di-(5-phenyl-3-pentenoyl)-piperazine has a biting peppery taste.

On repeating the work of Riccomanni, it was found by the authors that, although the crude product does have a pungent taste, this is not due to the diacyl piperazine, but to the presence of the di-5-phenyl-3-pentenoyl piperazonium salt, which can be removed from the crude product by water extraction.

The diacyl piperazine and the diacyl piperazonium salts in this investigation were prepared substantially in the manner recommended by Pollard and Adelson (*3*) for these types of compounds. The former were prepared by reacting the corresponding acyl chloride with piperazine hexahydrate, and the latter by heating equimolecular amounts of acid and base. Both series of com-

TABLE 1

DIACYL PIPERAZINES AND PIPERAZONIUM SALTS

Compound	Formula	Mp (uncorr.)	Nitrogen, %		Remarks
			Calcd	Found	
Piperazines					No taste; water-insoluble
Di-β-cinnamenyl acrylyl	$C_{26}H_{24}O_2N_2$	209–9.5°	7.04	7.08*	
Di-5-phenyl-2-pentenoyl	$C_{26}H_{32}O_2N_2$	150–1°	6.97	6.73*	Decompn on vac distn
Di-5-phenyl-3-pentenoyl	$C_{26}H_{32}O_2N_2$	Oil	6.97	5.67*	
Di-5-phenyl-n-valeroyl	$C_{26}H_{34}O_2N_2$	64.5–65°	6.89	7.15*	
Piperazonium Salts					Pungent taste: water-soluble
Di-β-cinnamenyl acrylyl	$C_{26}H_{28}O_4N_2$	196–7°	6.45	6.32; 6.35†	
Di-5-phenyl-2-pentenoyl	$C_{26}H_{36}O_4N_2$	152–3°	6.39	6.31; 6.27†	
Di-5-phenyl-3-pentenoyl	$C_{26}H_{36}O_4N_2$	126.7°	6.39	6.56; 6.64†	
Di-5-phenyl-n-valeroyl	$C_{26}H_{38}O_4N_2$	119.5°	6.31	6.44*	

* Analyses by Samuel P. Sadtler & Son, Philadelphia, Pa.
† Analyses by Micro-Tech Laboratories, Skokie, Ill.

pounds were then purified by recrystallization from appropriate solvents.

Table 1 gives some of the properties of the compounds prepared. The melting points of the piperazonium salts are not reliable values for determining their purity, as the salts split off water on heating to form diacyl piperazines. None of the diacyl piperazines has the pungent taste of pepper, whereas all the corresponding diacyl piperazonium salts have this characteristic flavor to a marked degree.

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A High-Pressure Cytolyzer

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Medical Division, Army Chemical Center, Maryland

In recent experiments at this laboratory concerned with the removal of cholinesterase from insect tissue, it was found that the usual instruments used for homogenizing tissue were unwieldy for large amounts of materials. The Potter-Elvehjem homogenizer and the Waring Blendor, for example, either did not break down the cellular structure so that the enzyme could be thoroughly extracted, or they inactivated the enzyme by production of heat. It was found that this could be avoided in the following manner: The tissue was subjected to a high pressure (1,800 psi) of nitrogen and was allowed to equilibrate with this pressure for 24 hr, after which time the pressure was released instantly with a "quick-release" valve. This had the effect of exploding the cells, and practically 100% cytolysis occurred.

The apparatus (**Fig. 1**) was constructed at very little cost from a small gas cylinder rated at 3,000 psi and therefore safe for this purpose. It was cut in the middle, and 1¼" steel sleeves with threads were roll-welded to the tank. This gave access to the chamber for placement and removal of the sample. The quick-release valve was a steam safety valve. The remaining portions of the apparatus were procured from surplus plumbing supplies, with the exception of a fitting for a 2,000 psi nitrogen cylinder.

This apparatus was tested on rat liver and brain, whole flies, and mold mycelium. It was successful in homogenizing the rat liver and brain, and the whole flies; the mold mycelium did not seem to be affected by the pressures. This type of apparatus can be used to homogenize large amounts of tissue; and cytolysis, at the time of pressure release, is done in extreme cold rather than heat, because of the drop in temperature when the pressure is released. For any experiments involving reproducible preparation of tissue brei or the removal of a biologically active material without heat inactivation, this method is very effective.

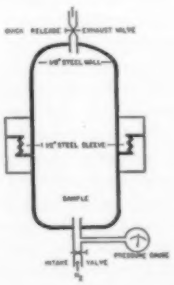

FIG. 1.

[1] The author is indebted to George Drumm and Robert Hallam for advice concerning the engineering details of this problem.

Comments and Communications

Term "Vitamin P" Recommended to be Discontinued

At the meeting of the Federation of American Societies for Experimental Biology in Atlantic City, April 17–21, 1950, the following recommendation of the Joint Committee on Biochemical Nomenclature of the American Society of Biological Chemists and the American Institute of Nutrition was adopted:

"The term 'vitamin P' was first applied to a substance present in lemon juice. It was said to be effective in reducing the extent of hemorrhages and extending the duration of life in scorbutic guinea pigs, and was also proposed for the treatment of vascular purpura. Subsequent studies have failed to substantiate these claims, and the identity of a substance of a vitamin nature has not been established. Continued application of the term 'vitamin P' to one or another of a group of polyphenolic substances will lead only to confusion. It is therefore recommended that the term 'vitamin P' should no longer be employed."

JOINT COMMITTEE ON NOMENCLATURE
H. B. Vickery, *Chairman*
E. M. Nelson
H. J. Almquist
C. A. Elvehjem

Color Standards

Through the Inter-Society Color Council we have received a reprint of the article "Robert Ridgway's Color Standards," by D. H. Hamly, published in SCIENCE (109, 605–608 [1949]). In it the mention of our *Colour Atlas* misrepresents its major contribution, and we would be very glad to see this point cleared up in your journal.

We quote: "Dade standardizes Saccardo's Latin Color Names on a Ridgway basis; Maerz and Paul make many references to Ridgway names and give their color equivalents; and Wilson, in his color charts for horticultural use, gives Ridgway names for his chips when possible, as does Villalobos in a recently published set of standards."

The fact is that we have not used names in our charts, neither Ridgway's nor any other, because we think that a terminology in words is a very rough means for designating the colors in a systematic, scientific classification. Moreover it would have been an extravagant enterprise to seek names for the 7,239 colors contained in our *Atlas*. So we have devised a special system of brief symbols that can be used to designate any practical number of colors.

But knowing that Ridgway's *Color Standards and Nomenclature* (which is now out of print and probably cannot be reproduced) has been widely used since 1912 by many naturalists, specially ornithologists, in many determinations, we considered it useful to add to our work a supplement of "Conversion Tables" for the 1,115 colors contained in Ridgway's, referring them to an equal number of samples actually contained in the *Colour Atlas*.

Of course, we have transcribed Ridgway names in this supplement as the obvious means for correlating his colors with out symbols. For instance, the molor named by Ridgway Andover Green, XLVII, 25 $''''i$, is precisely identified as equivalent to our Y-6-2^e; which symbol immediately suggests a color with a yellow hue, dark and very much discolored; or, in other words, a dark gray (value 6 in our scale of 20 "neutrals" in which black is 0 and white is 20) toned with a yellowish hue.

C. Y J. VILLALOBOS

Buenos Aires, Argentina

Genetic Effects in Man from Atomic Explosions and from Chronic Irradiation

The Atomic Energy Commission has recently issued for public use a 456-page book entitled *The Effects of Atomic Weapons*. Two pages of this are devoted to the "Genetic Effects of Radiation," and the present writer, among several others, is given credit for supplying material for the chapter containing the section. The writer appreciates the generosity of this acknowledgment, which is due to an entirely trivial note he prepared on a related subject, a note which was in fact unsuitable for use by the *Handbook*. He feels obliged to make it quite clear that he did not write any of the text appearing in the *Handbook*, did not see it before publication, and as a geneticist wishes to disclaim any responsibility for the contents. In a revision slip this section has been completely rewritten, and now has a very different character; the present letter is motivated by the contents of the original version, not of the revised one. Since, however, the writer has had no hand in this revision either, he has asked the editors to remove his name from any future editions.

A. C. FABERGÉ

Botany Department
University of Missouri

Separating Pages of Publications

The coating materials used in the manufacture of paper of current periodicals provide a beautiful, glossy surface, but once the pages get wet and then dry while touching one another, their separation is difficult. Such pages can be separated by soaking them in water and drying between interleaving newspapers, which can be changed once or twice to hasten dehydration. The publication can then be placed near an artificial source of heat until dry enough to prevent further sticking of the pages after the newspapers have been removed.

The print on the pages of such journals as SCIENCE and *Plant Physiology* is not destroyed by this method of treatment.

GEORGE R. JOHNSTONE

Department of Botany
University of Southern California, Los Angeles

Book Reviews

Colloid Science. James W. McBain. Boston: Heath, 1950. 450 pp. $6.00.

Advances in Colloid Science, Vol. III. H. Mark and E. J. W. Verwey, Eds. New York-London: Interscience, 1950. 384 pp. $7.50.

These two volumes, though treating the same subject, offer the most marked contrast in type. *Colloid Science,* the work of a single active mind with a lifetime of experience and reading to nourish it, takes into judicial consideration the whole field of colloid science. The second volume is a composite of many minds, each considering a separate specialized aspect of colloid science. The first has breadth and unity—the second explores its special topics in greater detail, though they remain unrelated. The first has an appeal to the general reader, the second is for the specialist.

To many a reader the most important trait of McBain's book will be its readability. There is an intense preoccupation with the subject, coupled with an ease in discussing it which, however much they may differ in form and content, recalls Dr. Johnson's *Lives of the Poets.* Both books were written by men of high intellectual abilities and lifelong familiarity with their subjects. Like Johnson, McBain includes personal and historical reminiscences, naturally, gracefully, and with no loss of seriousness. Filled though it is with references, and evidence of hours of reading and reflection, the book reads as if it had been written straight from a copiously filled mind. An occasional flash of ironical humor rewards the discerning reader.

The student of the subject will find much more. McBain discusses no topic without first examining its intellectual credentials and pronouncing on them. No process is better designed to reveal the quality of an author's mind. The quality of greatness in men is not as hard to recognize as it is to admit, but there are few who will deny its presence in this book. The mental attitude of a practicing scientist is so naturally and consistently maintained throughout, even to minute applications, that it gives an intellectual tone to the work. It is shown in numerous ways, as, for example, in the author's sturdy refusal to wed himself to hypotheses, in his avoidance of mathematical jargon, in his preference for the presentation of facts rather than the discussion of hypotheses, and in the creative forward step by which the sum of what has been done is used to point out what is next needful to be done. That step is taken so readily and frequently that the book is in itself a contribution to original research. Better than any philosophical discussion of "scientific method" this book is a rare and inspiring actual example.

The third volume of *Advances in Colloid Science* meets the intention of the original founder, the late E. O. Kraemer, by presenting a survey that is truly international in scope. The wisdom of the idea is fully demonstrated in the first contribution alone: "Atomic and Molecular Forces in Adsorption," by J. H. de Boer of the Netherlands. This is a well-coordinated review of a large body of recent work, much of it done by the productive Dutch school of colloid scientists. This article and the one by J. Th. G. Overbeck of Utrecht, on the "Quantitative Interpretation of the Electrophoretic Velocity of Colloids," discuss two active interests of the Dutch school. The value of these surveys will be appreciated in this country.

A high standard is held throughout. The primary emphasis is placed in nearly every case on the fundamental science of the phenomena, rather than on immediate practical applications. This emphasis is less pronounced in the final article on "Flotation." The two articles with the greatest commercial importance are those of J. H. Dillon on "Fatigue Phenomena in High Polymers," and of S. R. B. Cooke on "Flotation." Recognition of the physicochemical phenomena that occur during a fatigue test will help both in the design and the interpretation of future tests. The author's conclusion is interesting: "It may be necessary to set the practical indexes aside . . . in order to pry deeper into the true nature of fatigue in high polymers."

The remaining reviews are "Surface Chemistry and Colloids," by A. E. Alexander (England); "Lyogels," by A. E. Hauser and D. S. le Beau (U. S. A.) and "Ultracentrifugal Sedimentation of Polymolecular Substances," by Per-Olof Kinnel and B. G. Ranby (Sweden).

SYDNEY ROSS

Department of Chemistry
Rensselaer Polytechnic Institute

A Monograph of the Existing Crinoids. The Comatulids, Vol. 1—Superfamily Tropiometrida, Part 4c, the Families Thalassometridae and Charitometridae. U. S. National Museum, Bulletin 82. Austin Hobart Clark. Washington, D. C.: Government Printing Office, 1950. 383 pp., 32 plates. $2.25.

Parts 3, 4a, and 4b of this comprehensive monograph have been published previously, and the concluding Part 5 is in preparation. They include the systematic discussion of the species and higher groups of the living comatulids, or unstalked crinoids. The present volume contains systematic diagnoses of the 22 genera and 95 species comprising these two families, including keys to all the genera and species, historical data, detailed diagnostic features, habitat, localities in which each species has been found, and a complete synonymy.

On the 32 plates are excellent photographs and drawings of most of the species, including many type specimens. One genus, four species, and two varieties are described as new to science, and new names are proposed for two other species.

So thorough and comprehensive has been this study that it will not have to be repeated.

WESLEY R. COE

Scripps Institution of Oceanography

Annual Review of Plant Physiology, Vol. I. Daniel I. Arnon, Ed. Stanford, Calif.: Annual Reviews; London, England: H. K. Lewis, 1950. 364 pp. $6.00.

This volume is the first annual review exclusively covering plant physiological subjects. Edited by D. I. Arnon and L. Machlis of the University of California, it is published by Annual Reviews, Inc., as an offshoot from the *Annual Reviews of Biochemistry*, in the same manner as the *Annual Reviews of Microbiology*, which were started a few years ago. In a sense, therefore, the appearance of *Annual Review of Plant Physiology* signifies the rapid growth and coming-of-age of the subject as an independent branch of biological science. The advantages to be gained from such a journal and the need for it have long been recognized, because it has been impossible in the past to provide systematic coverage of many topics in plant physiology. This has been particularly true for important topics in the field without a predominantly chemical or biochemical slant but also, to some extent, for the topics formerly covered in the *Annual Reviews of Biochemistry*. As a result of limitations of space, reviewers tended to present brief, disconnected statements and references rather than an evaluation of the material that would be useful to the uninitiated reader looking for general information. The increased freedom and change in orientation provided the authors by the knowledge that they are writing primarily for biologists are perhaps as great advantages as the increase in scope.

Titles of some topics have been transferred intact from the *Annual Reviews of Biochemistry*, others have been subdivided, and some new ones have been added. For example, the topic "Plant Growth Substances," formerly often covered as peripheral subject matter such diverse items as plant tropisms, the influence of light on plant growth, physiology of cell wall growth, and growth-regulating substances in horticulture and herbicides—to mention the titles of the 5 topics in this general category which appear in the present volume. The title "Mineral Nutrition of Plants" has been retained, but two excellent articles, "Aspects of Soil Chemistry in Relation to Inorganic Nutrition" and "Soil Moisture in Relation to Growth," have been added. Furthermore, it appears from the table of contents of the forthcoming Volume II that the more integral parts of this topic, such as mechanisms of absorption and transport, nutrient requirements, and functional roles of the elements, will also be presented in separate articles.

The present volume has given due emphasis to plant metabolism. It includes comprehensive treatments of the following: carbon dioxide fixation in green plants, transformation of sugars in plants, organic acid metabolism, respiration of higher plants, and postharvest physiology and biochemistry of fruits. The first article of this group summarizes the new evidence for photosynthetic intermediates, which has appeared as brief papers in various chemical and botanical journals. The rapid advances in the past few years which have resulted from the application of vastly improved analytical tools (isotope analysis and chromatography) toward the solution of the century-old problems of photosynthesis perhaps constitute a major achievement in biology. An integrated summary of this work is therefore of great general interest. In contrast, the work on plant katobolism in general and on respiration in particular appears to lean too heavily on studies of animals and microorganisms for information and guiding principles to have attained a general interest in its own right. The articles of this group, however, do contain much new material of special interest to plant physiologists, and perhaps the present clear summary of the status of plant respiration will make for more rapid progress in this field.

A paper entitled "Nitrogen Constituents in Plants with Special Reference to Chromatographic Methods," which is also a critical evaluation of recent work on several aspects of nitrogen metabolism, and an article on "Water Relations in Plant Cells and Tissues" complete the list of 15 topics covered in this volume.

It is hoped that the excellent standard set by this first issue can be maintained in the future. This would appear to be difficult in view of the present rate of progress. Unless a real effort is made to include summary articles of interesting but less common lines of research which are less adapted to general reviews, there will be excessive repetition.

The point has been made that the journal will provide an opportunity for the inclusion of applied plant physiology in horticulture, forestry, and other fields. The question may be raised, however, whether the gains from such new associations of subject matter, valuable as they may be, can outweigh the losses from dissociation with biochemistry and certain aspects of animal physiology. In the reviewer's opinion it is a cause for regret that the inauguration of the present journal inevitably will lessen the contacts of plant physiologists with other fields and persons dealing with basic chemical and biological research. By the exclusion of plant physiological topics from the *Annual Reviews of Biochemistry*, access to plant physiological literature will be less readily available to physical scientists and animal biologists, and the material covered in that journal will be, if not less accessible, at least less frequently encountered and read by many plant physiologists. The latter point may be the more serious. With the rapid expansion and emphasis on practical aspects of plant physiology, it is becoming increasingly urgent for plant physiologists to keep in touch with developments in the basic sciences which provide the only means for further advance. It is hoped that the drawbacks inevitably associated with the founding of the present journal will be overcome in the near future by this or still another annual review that will cover significant advances in the physical sciences as applied to problems in biology.

FOLKE SKOOG

Department of Botany
University of Wisconsin

Association Affairs

The Cleveland Meeting—December 26–30, 1950

V—The Programs in Anthropology, Psychology, Education, and the History and Philosophy of Science

THE following programs constitute a fifth portion of the advance information on the 117th Meeting of the AAAS. Part I—**The Annual Science Exposition**, Part II—**The Programs in Mathematics, Physics, Astronomy, and Chemistry** (in part), Part III—**The Programs in Biology and Medicine**, and Part IV—**The Programs in Geology, Geography, Engineering, and the Social Sciences** appeared in SCIENCE for October 27 and November 3, 10, and 17.

PROGRAM OF SECTION H—ANTHROPOLOGY

Session 1. Thursday morning, December 28, jointly sponsored by the Society for Research in Child Development; Wayne Dennis, University of Pittsburgh, presiding.

1. "Growth and Body Build: Problems Involved in Studying the Consistency of Body Type in Children," E. L. Reynolds, Antioch College.
2. "Mixture, Flexibility, and Culture Growth." J. L. Angel, Philadelphia.
3. "The Use of Imaginative Behavior for Cross-Culture Comparisons of Children." D. C. McClelland, Wesleyan University.
4. "The Psychological Ecology of the Midwest." R. G. and L. S. Barker and H. F. Wright, University of Kansas.
5. "Mother and Child as an Intercommunicating System." Margaret Mead, American Museum of Natural History.

Session 2. Thursday afternoon, December 28, jointly sponsored by the Society for Applied Anthropology; Margaret Mead presiding.

1. "The Analysis of Human Relations with the Interaction Chronograph." E. D. Chapple, E. D. Chapple Co.
2. Discussion.

Session 3. Friday morning, December 29, *American Character and the Administration of Native Peoples*, joint session with the Society for Applied Anthropology; John Useem, Michigan State College, presiding.

1. "American Stereotypes and Personality Structure in a Mexican Indian Village." N. D. Humphrey, Wayne University.
2. "Training Americans for Working in Foreign Cultures." E. A. Kennard, Department of State.
3. "The Concepts of Dissociation and Awareness as Factors in Change in the Cross-Cultural Process." E. J. Hall, Jr., Bennington College.
4. "Patterns and Policies of Administration of American Samoa." G. Macgregor, Department of the Interior.

Session 4. Friday afternoon, December 29, *Government and the Administration of Native Peoples*; John Useem presiding (reported last week).

Session 5. Saturday morning, December 30, *Linguistics and Anthropological Theory*; Mark Hanna Watkins, Howard University, presiding.

1. "Some Ethnological Theories Tested by Reference to Linguistic Data." J. Greenberg, Columbia University.
2. "What is a Word?" G. A. Reichard, Barnard College.
3. "Linguistics and Meaning." H. L. Smith, Jr., Department of State.
4. "The Aims and Tasks of General Semantics." S. I. Hayakawa, Chicago.

Session 6. Saturday afternoon, December 30, contributed papers; James B. Griffin, University of Michigan, presiding.

1. "A Suggested Approach to the Study of some Reservation Communities." E. Friedl, Queens College.
2. "Some Problems of Tlingit Ethnology." Frederica de Laguna, Bryn Mawr College.
3. "Prehistoric Stone Sculptures of the Columbia-Fraser Region." P. S. Wingert, Columbia University.
4. "The Prehistoric Sequence in the St. Louis Area." J. B. Griffin, University of Michigan.
5. "Stratigraphic Excavations at Cahokia and Related Sites." A. C. Spaulding, University of Michigan.
6. "The 'Shinumo'—an Early Formulation of Pueblo Archaeology." V. H. Jones, University of Michigan.

PROGRAM OF SECTION I—PSYCHOLOGY

Session 1. Wednesday evening, December 27, Vice-presidential Addresses of Section I and Section Q—Education, a joint program; Dean A. Worcester, University of Nebraska, secretary, Section Q, presiding.

1. Address of vice president, Section I. Douglas H. Fryer, New York University.
2. Address of vice president, Section Q. Palmer O. Johnson, University of Minnesota.

Sessions 2–3. Seminar on *Psychological Research in the Air Force*; Walter F. Grether, Aero Medical Laboratory, Wright-Patterson Air Force Base, presiding.

Part I. Thursday morning, December 28.

Part II. Thursday afternoon, December 28.

Representation from USAF School of Aviation Medicine, Aero Medical Laboratory, and Human Resources Research Center.

Session 4. Thursday morning, December 28, contributed papers; Donald N. Meyer presiding.

1. "Automatic Writing as a Means for Investigating Experimentally Induced Conflicts." P. L. Harriman, Bucknell University.

2. "Observations on Carbon-Dioxide Therapy." C. F. Poole.

3. "Patterns of Anxiety Management Determined by Instrumental Procedure." M. H. Kroutz.

4. "Behavioral Effects of Total Body." E. Furchtgott, University of Tennessee.

5. "Psychology of Community Participation." L. W. Kay, New York University.

6. "Cooperation between the Cat and the Rat" (motion picture). L. S. Tsai, Tulane University.

7. "Therapeutic Effort and Therapeutic Situation." F. Wyatt, Cushing VA Hospital.

8. "An Investigation of the Background Experiences of Socially Accepted and Rejected Adolescent Boys at Three Economic Levels." M. R. Feinberg, Brooklyn College; and D. H. Fryer, New York University.

Sessions 5–6. Seminar on *Psychological Research in the Navy*; J. W. Macmillan, Human Resources Division, Department of the Navy, presiding.

Part I. Thursday morning, December 28.

Part II. Thursday afternoon, December 28.

Representation from Research Division, Bureau of Naval Personnel; Human Engineering Branch, Special Devices Center, Sands Point, Long Island; Psychology Branch, Naval Research Laboratory; Aviation Psychology Branch, Bureau of Medicine and Surgery; and Human Resources Division, Office of Naval Research.

Session 7. Thursday afternoon, December 28, contributed papers on *Physiological Psychology*; Roland C. Davis, Indiana University, presiding.

1. "An Enzyme-Substrate Mechanism in the Eye and CNS which Responds to Stimuli." P. S. Shurrager, Illinois Institute of Technology.

2. "Experiment Investigation of Motor Control in Psychiatric Patients under Stress." R. B. Malmo and C. Shagass, McGill University; D. J. Belanger; and A. A. Smith.

3. "Psychomatics and Psychophysiology: Experimental Studies." J. B. Lacey.

4. "Avoidance Conditioning in Normal Dogs and in Dogs Deprived of Normal Autonomic Functioning." C. Wynne.

5. "Recent Neurological Findings Bearing on Emotion, Sleep and Wakefulness." D. B. Lindsley, Northwestern University.

6. "A Miniature Transmitter for the Broadcasting of Bioelectric Potentials." N. J. Holter, Holter Research Foundation, and J. A. Gengerelli, University of California at Los Angeles.

Sessions 8 and 9. Seminar on *Psychological Research in the Army*; Donald E. Baier, Adjutant General's Office, presiding.

Part I. Friday morning, December 29.

1. "Human Resources Research in the Army." Harry F. Harlow, Research and Development Division of the General Staff (Logistics).

2. "Personnel Research." Charles I. Mosier, Adjutant General's Office.

Part II. Friday afternoon, December 29.

3. "Psychophysiology, Experimental and Clinical Psychology." Charles S. Gersoni, Surgeon General's Office.

4. "Review of Research in Human Resources Relating to the Creation of Effective Combat Forces." Richard Williams, Operations Research Office.

Session 10. Friday morning, December 29, Symposium on *The Role of the Frontal Lobes in Behavior*; Roland C. Davis presiding.

Participants: Harry F. Harlow, University of Wisconsin; Ward C. Halstead, University of Chicago; Karl Pribram, Yale University; H. H. King; and Hans Lukas Teuber, New York University College of Medicine.

Session 11. Friday morning, December 29, Seminar on *Psychological Research in the Public Services*; Harold M. Hildreth, Veterans Administration, presiding.

Participants: John C. Eberhart, U. S. Public Health Service; James Mitchell, U. S. Civil Service Commission; Dean R. Brimhall, Civil Aeronautics Authority; Katherine Bain, Children's Bureau, Social Security Administration; John P. Shea, U. S. Department of Agriculture; and H. M. Hildreth, Veterans Administration.

Research summaries will be presented for these other agencies: U. S. Employment Service; U. S. Office of Education; Office of Vocational Rehabilitation; Bureau of Prisons; U. S. Board of Parole, Department of Justice; Gerontology Section, National Heart Institute; and U. S. Coast Guard Academy.

Session 12. Friday afternoon, December 29, seminar on *Psychological Research in Industrial Consulting Firms*; Harold A. Edgerton presiding.

Session 13. The joint program with Section F—Zoological Sciences and the American Society of Zoologists (symposium on *Genetics and Behavior*) appeared in SCIENCE November 10.

AMERICAN HOME ECONOMICS ASSOCIATION

Session. Thursday afternoon, December 28, *Child Development and Home Economics Education*; Helen Hunscher, Western Reserve University, presiding.

1. "Self-Understanding as a Goal in Education." Arthur T. Jersild, Teachers College, Columbia University.

2. "Interpreting Skeletal Maturity Indicators for Children." Idell Pyle, Western Reserve University.

3. Discussion.

PROGRAM OF SECTION Q—EDUCATION

Session 1. Tuesday afternoon, December 26, panel on *Visual Performance as Applied by Industrial and Educational Management*; N. Franklin Stump, Bausch & Lomb Optical Co., presiding.

1. "A Medical Experience with Visual Performance in Providing Tangible Returns to Management." Hedwig S. Kuhn, Kuhn Clinic Hospital.

2. "Some Experience with an Industrial Vision Program." J. H. Rapparlie, U. S. Rubber Company.

3. "An Investigation of the Relationship between Visual Performance and Accident Performance of

Street Car Operators." William E. Hoehn, Pittsburgh Railways Company.

4. "The Practical Application of Selective Visual Standards to Certain Occupations." Roger J. Desnoyers, Northern Electric Co., Ltd.

5. "An Analysis of Four Visual Screening Tests at Grades Four to Seven." Helen M. Robinson, University of Chicago.

Session 2. Tuesday afternoon, December 26, contributed papers; H. H. Remmers, Purdue University, presiding.

1. "Escape from Chaos: A Program of Integrated Education." Oliver L. Reiser, University of Pittsburgh.

2. "Literature Science: New A.A.A.S. Section?" William F. Hewitt, Jr., Howard University.

3. "Education for Citizenship in a Multi-Culture Society." Stewart G. Cole, National Conference of Christians and Jews.

4. "A Study of Terminal Education in American Universities." Woodson W. Fishback and Douglas E. Lawson, Southern Illinois University.

5. "Setting up of Large-Scale Educational Programs." G. E. Jensen, Grinnell College.

6. "The Role of Song in the Emergence of the Speech and Thought Processes, with Implications for Education." Viola A. Brody, Milwaukee.

Session 3. Wednesday morning, December 27, joint session with American Educational Research Association; Arthur E. Traxler, Educational Records Bureau, presiding.

1. "New Concepts in Education." Stuart A. Courtis, University of Michigan.

2. "Selection of Doctoral Candidates in Education." F. H. Finch, University of Illinois.

3. "Adolescents' Interpretations of Emotionally Toned Situations." Alma Long, Purdue University.

4. "Pupils' Interest in Television in Relation to Educational Attainment and Personal Adjustment." Paul A. Witty, Northwestern University.

5. "Test Interpretation with Resistant Students." Dugald S. Arbuckle, Boston University.

Session 4. Wednesday morning, December 27, contributed papers; Palmer O. Johnson, University of Minnesota, presiding.

1. "The Differential Effects of Partial and Continuous Reward upon the Acquisition and Elimination of a Running Response in a Two-Choice Situation." J. C. Stanley, Jr., George Peabody College for Teachers.

2. "Sex Differences and Legal School Entrance Age." Frank R. Pauly, Tulsa Public Schools.

3. "Extraordinary Achievements and Serious Shortcomings of Technical Education in America." Arthur L. Williston, Dedham, Massachusetts.

4. "Intelligence as a Factor in the Learning which Results from the Use of Educational Sound Motion Pictures." Herbert A. Smith, University of Nebraska.

5. "The Effect of a Knowledge of Biological and Physical Sciences on Learning in General Psychology." George G. Mallinson, Western Michigan College of Education.

6. "Binaural Recording and Playback—An Audio-Aid for Teacher Preparation Supervisory Practice." John H. Semon, Ithaca, New York.

7. "Willingness to Make Negative Responses as a Measure of Maturity." Warren F. Findley, Educational Testing Service, Princeton, New Jersey.

Session 5. Wednesday afternoon, December 27, contributed papers; Francis D. Curtis, University of Michigan, presiding.

1. "A Study of Conservation Education in the United States." Helen B. Ross, Cornell University.

2. "Relation of Teachers' Salaries to Subsequent Economic Progress of States." Vernon Bowyer, Board of Education, Chicago.

3. "The Development and Administration of the State Program of Educational Research." J. Gayce Morrison, The University of the State of New York.

4. "Teaching Procedures in Twenty-Eight Midwestern Colleges and Universities." J. G. Umstattd, University of Texas.

5. "Some Applications of Educational Concepts to Industrial Management." J. Elliott Janney, Rohrer, Hibler & Replogle.

6. "Methods of Teaching Science at the Kindergarten and Primary Level." Mary Haga, Minneapolis.

Session 6. Wednesday afternoon, December 27, joint session with American Educational Research Association; Palmer O. Johnson presiding.

1. "Evaluation in General Education." Max D. Engelhart, Chicago City Junior College.

2. "Nonverbal Tests in the Measurement of Intelligence." Kenneth W. Vaughn, Rohrer, Hibler & Replogle.

3. "Development of Word Recognition Skills—Fourth through Twelfth Grades." Frances Triggs, University of Maryland.

4. "The Age Factor in Personality Appraisal." Sister M. Amatora Tschechtelin, St. Francis College.

5. "Generalizations in Spelling with Special Reference to Methods." Jake J. Hendricks, Education Department, The Macmillan Company.

6. Business Meeting of the section.

Session 7. Wednesday evening, December 27, joint session with Section I—Psychology.

Session 8. Thursday afternoon, December 28, joint program with Foundation for Integrated Education; symposium on *Integrative Studies for General Education*; Palmer O. Johnson presiding.

1. "Objectives and Nature of Integrative Studies." Kirtley F. Mather, Harvard University.

2. "Teamwork in Building a General Key Concept." Schiller Scroggs, Oklahoma Agricultural and Mechanical College.

3. "The Role of a Biological Field Theory in Education." F. L. Kunz, Foundation for Integrated Education.

4. "Integration in the Sciences." Henry Margenau, Yale University.

5. Discussion.

AAAS Cooperative Committee on the Teaching of Science and Mathematics

Session. Saturday morning, December 30; symposium on *Teacher Training and Teachers' Workshops*; Ralph W. Lefler, Purdue University, presiding.

Speakers: Francis W. Sears, Massachusetts Institute of Technology; Leonard O. Olsen, Case Institute of Technology; and Russell S. Poor, Oak Ridge Institute of Nuclear Studies.

Science Teaching Societies Affiliated with the AAAS

The American Nature Study Society, the National Association of Biology Teachers, the National Science Teachers Association, and the AAAS Cooperative Committee on the Teaching of Science and Mathematics have cooperated in the preparation of three joint programs for the mornings of December 27–29:

Wednesday—"Outdoor Resources for Learning Science"

Thursday—"Human Resources for Learning Science"

Friday—"Industrial and Technological Resources for Learning Science"

National Science Teachers Association

Other sessions of the National Science Teachers Association begin Wednesday afternoon, December 27, and conclude Friday evening, December 29, with Session II of the Fourth National Conferenec on Industry-Science Teaching Relations.

National Association of Biology Teachers

Other sessions of the National Association of Biology Teachers begin Wednesday afternoon, December 27, and conclude Saturday with the joint field trip with the American Nature Study Society, led by Arthur A. Allen, Cornell University, Roger Tory Peterson, and others. Included are a luncheon, Thursday, December 28, and a session on "Special Techniques in the Teaching of Biology."

American Nature Study Society

Other sessions of the American Nature Study Society begin Wednesday afternoon, December 27, and conclude with Saturday's all-day field trip to Brecksville Reserve and the South Chagrin Reservation. The ANSS Annual Banquet will be Friday evening; Arthur A. Allen will give an illustrated lecture.

Program of Section L—History and Philosophy of Science

Session 1. Friday morning, December 29, joint session with the History of Science Society (which arranged the program) and the Philosophy of Science Association, symposium on *The Social Relations of Science in Historical Perspective*; Richard H. Shryock, The Johns Hopkins University, presiding.

1. "Electrical Science and the Development of the Electrical Manufacturing Industry in the United States, 1875–1900." Harold C. Passer, Princeton University.
2. "The Linkage of Science with its Cultural Matrix." David Hawkins, University of Colorado.
3. "Persecution and Personality in Science History." Mark Graubard, University of Minnesota.

Sessions 2–5 will be held jointly with the Philosophy of Science Association.

Session 2. Friday afternoon, December 29, contributed papers; C. West Churchman, Wayne University, presiding.

Session 3. Friday evening, December 29, symposium on *Scientific Method and Psychoanalysis*; George J. Mohr, University of Illinois and University of Chicago, presiding.

Session 4. Saturday morning, December 30, symposium on *Methodological Issues in Recent Studies of National Character*; Robert Redfield, University of Chicago, presiding.

Session 5. Saturday afternoon, December 30, symposium on *Logic and the Laws of Nature*; Gustav Bergmann, University of Iowa, presiding.

History of Science Society

The sessions of the History of Science Society begin Thursday afternoon, December 28, and conclude with the Annual Dinner, Friday evening, December 29.

The Preconvention Issue of Science (December 8) will provide full details with respect to the special sessions, symposia sponsored by the Association and the programs of the AAAS Science Theatre—which will show the latest in domestic and foreign scientific films. The approximately 70 titles in the Science Theatre, arranged in 6 four-hour programs that will be repeated, require a total of 24 hours' projection time. Those interested in visual education will find these sound movies, most of which are in color, very much worth while.

Raymond L. Taylor
Assistant Administrative Secretary

News and Notes

International Physics Abstracting Service

Elmer Hutchisson

Case Institute of Technology, Cleveland, Ohio

In June, 1949, Unesco called an international conference on the abstracting of scientific literature. Among the many recommendations included in the final report of this conference was one which suggested that, if possible, a single international physics abstracting journal be established. The members of the conference realized, however, that it would be unwise to set up such a new journal without first attempting to modify existing abstract journals so as to make them more international in scope. To carry out the specific recommendations of this conference with respect to physics, a Unesco subject committee in this field was established. This committee consists of:

Paul Bourgeois G. A. Boutry J. H. Awbery Elmer Hutchisson	International Council of Scientific Unions
S. Whitehead A. C. Menzies	The Committee of Management of *Science Abstracts*
Jean Wyart G. Kerssaint	Centre de Documentation du Centre National de la Recherche Scientifique
J. B. Reid (Unesco)	
Ronald Fraser (Unesco/Icsu Liaison officer)	

The first meeting of this committee was held in London, September 26 and 27, 1950.

To be really international a physics abstracting journal would need to carry either abstracts of which some would be in one language and some in another, or duplicate abtracts in more than one language. If one of the existing journals were modified to include abstracts partly in one language and partly in another, it is quite clear that the usefulness of this journal would be greatly decreased, especially among younger students who have not yet acquired facility with foreign languages. If abstracts were duplicated in several languages, each subscriber would receive material he would not use, and each individual's cost would be considerably increased.

In view of this situation the committee decided that a preferable idea would be to plan an international abstracting "service" rather than a single international journal. In this international service there would be several editions, each in a separate language and, wherever possible, existing journals would constitute the official editions. For example, *Physics Abstracts* could be considered the English edition, and the *Bulletin Analytique* would constitute the French edition. Under this proposal each journal would retain a measure of its own individuality and yet be part of the international plan. The committee recommended further that this service be established under the general sponsorship of either the International Conference of Scientific Unions (Icsu) or the International Union of Pure and Applied Physics (Iupap). With such sponsorship it is hoped that possibly the *Physikalische Berichte* could be brought into the same international scheme, and, if a Spanish or Russian abstracting journal were started, they might also follow the same pattern.

The definite improvements which it is hoped may be achieved through this proposal are:

1. The inclusion of an author's abstract prepared essentially in accordance with the Royal Society rules with each original research paper.

2. The sending of the author's abstract in page-proof stage by air mail to the abstract editor in the corresponding language—i.e., physics journals in English would send abstracts to *Physics Abstracts*, journals in the French language to the *Bulletin Analytique*, etc.

3. Abstract editors would, by mutual agreement, exchange abstracts, thus decreasing lag in publication time of abstracts and assisting each abstract journal in obtaining wider coverage.

4. Increased cooperation among abstract editors to obtain the most efficient classification and indexing methods.

5. Increased international cooperation through the sponsorship of this abstract service by Icsu or Iupap.

The recommendations of this Unesco committee are to be transmitted to Icsu and, if adopted, a mechanism will be set up to put the international abstracting service into operation. Pending this action the editors of *Physics Abstracts* and the *Bulletin Analytique* are collaborating to facilitate their editorial work and to improve the efficiency of their journals without, at this time, changing their internal structure.

About People

A recent visiting scholar at the University of Delaware, and guest of the Department of Biological Sciences, was **Anton J. Carlson**, Frank P. Hixon distinguished service professor of physiology (emeritus) at the University of Chicago. While at the university he inspected instruction and research activities and held informal conferences with staff members and graduate students in the department.

A. S. D'Amore, chief of the Department of Surgery at the School of Aviation Medicine, Randolph AFB, has been named base surgeon for Langley AFB, Virginia. Formerly chief of surgery at the Air Force school, he was the first medi-

cal officer to serve with paratroopers and the second medical officer to qualify for the Parachute Badge.

Ralph I. Dorfman has been appointed associate director of laboratories and member of the research staff of the Worcester Foundation for Experimental Biology. Dr. Dorfman, who has been associate professor of biochemistry at Western Reserve University, will join the Worcester Foundation staff on January 1, and will take charge of research projects concerned with steroid hormone metabolism.

William A. Hamor, assistant director of Mellon Institute, has been named by the Pittsburgh Section of the American Chemical Society to receive its Pittsburgh Award for 1950. The award, a bronze plaque that is granted annually for outstanding service to chemistry, will be presented to Dr. Hamor at a dinner in the University Club of Pittsburgh on December 21. Dr. Hamor is a member of the Scientific Personnel Committee of the AEC and the Scientific Manpower Branch of the Department of the Army, General Staff. He is also a member of the Research Advisory Council of the Industrial Hygiene Foundation of America.

Walter H. Hodge, of the Department of Botany, University of Massachusetts, has been granted a leave of absence to serve as plant explorer for the Division of Plant Introduction, USDA. He will go to South Africa to search for species of higher plants yielding cortisone precursor compounds.

George Taylor has been appointed to the keepership of the Department of Botany in the British Museum of Natural History to succeed **J. Ramsbottom**. In 1934–35, Dr. Taylor was joint leader of the museum's expedition to Ruwenzori and the mountains of East Africa, and in 1938 he visited the Tsangpo Himalaya in southeastern Tibet to make botanical collections for the museum. His work has been mainly on flowering plants.

Visitors

The National Bureau of Standards recently entertained the following visitors from abroad: **G. Abetti**, Royal Observatory of Arcetri, Florence; **Yuichiro Aono**, Ionospheric Propagation Section, Engineering and Monitoring Division, Japanese Radio Regulatory Agency, Tokyo; **M. H. Muller**, Silk Testing House, Zurich; **H. L. Bredée**, Algemene Kunstzyde Unie, Arnhem, Netherlands; **Jean Duval**, of the Association Française de Normalisation (AFNOR), Paris; **L. Herman**, Section d'Astrophysique, Observatoire de Paris, Meudon; **Rudolf Signer**, Laboratory of Organic Chemistry, University of Berne; **Magdalena A. Templa**, Institute of Science, Manila; **Harold M. Glass**, British Standards Institution, London; **Charles Manneback**, University of Louvain; **Louis van den Berghe**, Institut pour la Recherche Scientifique en Afrique Central (IRSAC), Costermansville, Belgian Congo; **Eugene van Dyck** and **J. A. van der Donckt**, Bell Telephone Manufacturing Co., Antwerp; **B. G. Churcher** and **F. R. Perry**, High Voltage Laboratory, Metropolitan-Vickers, Manchester, England; **H. Rinia**, **F. M. Penning**, and **E. W. Gorter**, Philips Research Laboratory, Eindhoven, Netherlands; **Masanori Sato**, Industrial Research Institute, Osaka; **M. Okada**, Department of Welding Engineering, Osaka University; **T. Ono**, Department of Civil Engineering, Nihon University, Tokyo; and **G. Yoshimoto**, Polytechnical Institute, Osaka University.

R. Tavernier, of the University of Ghent, and director of the Belgium Soil Survey, spoke at the recent meeting of the Soil Science Society of America, in Cincinnati, in his role as president of the International Society of Soil Science. He is studying soils and research methods with scientists of the Division of Soil Survey, USDA, and visiting several research institutes in the East and Middle West.

Peter Martinovitz, of the University of Belgrade Medical School, gave a series of lectures during the first part of November on whole organ culture. Dr. Martinovitz is engaged in studies on the whole organ culture of the adrenals and the anterior pituitary.

Grants and Awards

Research grants amounting to $36,200 have been received by the recently expanded Department of Chemistry, **Florida State University**, Tallahassee. The Office of Naval Research has granted Karl Dittmer, head of the department, $12,300 to study the structural bases of metabolite antagonists. The Research Corporation has granted Ernest Grunwald $5,000 for studies of solvation energies in polar solvents, and Werner Herz $3,500 for research on the reduction of ketoepoxides. Earl Frieden has been granted $4,800 by the National Institutes of Health for an investigation of the biochemistry of amphibian metamorphosis. The National Institutes of Health is also supporting a study of the mechanism of amino acid antagonism with $8,100 under the direction of Karl Dittmer. A grant-in-aid of $2,500 for the preparation of amino acid antagonists for cancer studies has been made to Karl Dittmer by the Sloan-Kettering Foundation.

A research grant for investigation of a genus of fungi and its antibiotic properties has been made to the Pharmaceutical Foundation of the University of Texas by Sharpe & Dohme. Studies will be directed by Henry M. Burlage, dean of the College of Pharmacy.

The Johns Hopkins University has awarded its new **Charles F. Kettering fellowship** to Gabriel de la Haba, a young Puerto Rican biologist who is doing research in the field of micronutrients. Dr. de la Haba is investigating the problem of how plants and microorganisms make use of inorganic nitrogen compounds, such as nitrates, nitrites, and ammonia, and utilize or transform them into more complex nitrogen compounds, such as amino acids.

The Council Award, highest honor bestowed by the Wisconsin State Medical Society, has been awarded to Armand J. Quick, director of the

Department of Biochemistry at Marquette University School of Medicine. Cited for his attainments in the science and art of medicine and surgery, and for his service to humanity, Dr. Quick is well known for his extensive research in the field of blood coagulation and hemorrhage.

Fellowships and Prizes

The American Institute of Nutrition is accepting nominations for the **B Complex Award** of $1,000 established by Mead Johnson and Company to promote research on B complex vitamins. The award will be given to the laboratory or clinical research worker in the U. S. or Canada who has published the most meritorious report on the subject in 1950. Nominations should be sent to E. E. Snell, Department of Biochemistry, University of Wisconsin. **The Borden Award in Nutrition** for research emphasizing the nutritive significance of components of milk or dairy products consists of $1,000 and a gold medal. Nominations should be sent to Hazel K. Stiebeling, Bureau of Human Nutrition and Home Economics, USDA, Washington 25, D. C. **The Osborne and Mendell Award** of the Nutrition Foundation, Inc., is for accomplishments in the general field of exploratory research in nutrition. Nominations for the $1,000 award are open to research workers in the U. S. and Canada and investigators from other countries. Chairman of the nominating committee is Robert V. Boucher, Pennsylvania State College. Nominations and data on the accomplishments of the nominees for each award must be sent to those indicated above by *January 1, 1951.*

The Public Health Service is offering 122 one-year rotating internships in 11 of its U. S. Marine Hospitals, to begin *July 1, 1951.* These are open to graduates of approved medical schools, and appointments are made on a competitive basis, according to the Uniform Intern Placement Plan. Applicants must qualify for a commission as assistant surgeon in the Reserve Corps of the USPHS, and must express intent to serve for a year after completion of internship. Applications and further information may be obtained from USPHS, Federal Security Agency, Washington 25, D. C.

The **Charles A. Coffin Fellowships** in electricity, physics, and physical chemistry, and the **Gerard Swope Fellowships** in industrial management, engineering, the physical sciences, and other scientific and industrial fields, are again offered by the General Electric Education Fund, and applications are being accepted for 1951–52. Grants up to $1,500 annually will be made to college graduates who wish to continue individual study and research in these fields. Grants of $500 are available for specific apparatus or other research expense. Applications may be obtained from the libraries of engineering schools, department heads and professors in electrical and mechanical engineering, physics, chemistry, and metallurgy, and deans of graduate schools, and must be sent to the Secretary, General Electric Company Education Fund, Schenectady, N. Y., by *January 1.*

Colleges and Universities

The following scientists recently joined the staff of the **Johns Hopkins University Applied Physics Laboratory,** Silver Spring, Md.: Everette J. Hardgrave, Hugh E. Riordan, Ronald E. Bowles, Robert E. Dye, Wayne A. Fey, William J. Keck, Paul D. Ulm, Herbert Ruderfer, Michael Shandor, Fergus J. Wood, Daine C. Maxwell, Morris Ribner, Thelma Jo Noble, Ira B. Mullis, Willard C. Reynolds, Harold B. Coleman, Wentworth Wilder, Jr., Cloyd Marvin, Pierre A. Portmann, François N. Frenkiel, Herbert Dereziewicz, Schubert A. Stricklett, and Rodney Morison.

The first non-AEC owned and operated nuclear reactor in the U. S. will be built by the **Consolidated University of North Carolina,** using nuclear fuel loaned by the AEC. The proposed reactor, which will provide facilities for nuclear engineering research and education, will be located on the campus of the North Carolina State College, Raleigh. Present design calls for a low-power reactor having a maximum power level of 10 kw, which will use enriched fuel containing not over one kg of fissionable uranium 235. The reactor will be housed in a special laboratory building to be erected with a fund of $200,000 that has been provided by the Burlington Mills Foundation. The North Carolina reactor will be a "water boiler" type, similar to one that has been in operation at the Los Alamos Scientific Laboratory since 1944.

The Postgraduate Division of the **University of Texas Medical Branch,** Galveston, announces four postgraduate courses on medical preparedness for atomic warfare. These will be held on December 15 and 16, in Corpus Christi, January 12 and 13, at Tyler, February 2 and 3, at El Paso, and February 16 and 17, at Lubbock. A preliminary session is being held this month for the Galveston–Houston–Beaumont area. The course will include material on organization for medical preparedness, principles of handling and sorting casualties, field dressing, diagnosis and treatment of burns, traumatic injuries, and radiation sickness, and the collection and preservation of necessary supplies. Speakers will be drawn from the staff of the Medical Branch, and will include experts in the biological effects of radiation and surgical specialists in the treatment of burns and traumatic injury.

A two-day program held October 13 and 14 marked the closing of the centennial celebration of the **Woman's Medical College,** Philadelphia. Detlev W. Bronk, president of The Johns Hopkins University, moderated a symposium on premedical education at which the following spoke: A. V. Hill, Foulerton professor of the Royal Society and Nobel Laureate; George W. Corner, Department of Embryology, Carnegie Institution, Baltimore; Katharine E. McBride, Bryn Mawr College; and Donald Ramsey Young, Russell Sage Foundation. The convocation dinner was addressed by Capt. Charles F. Behrens, director, Atomic Defense Division, Bureau of Medicine and Surgery of the Navy Department, and Medical Officer in Command of the Naval Research Institute, National Medical Center, Bethesda, Md.

Willard Cole Rappleye, dean, College of Physicians and Surgeons, gave the convocation address and the following received honorary degrees: Alice Hamilton, Elise L'Esperance, Florence Seibert, Florence Rena Sabin, Marian Anderson, Detlev W. Bronk, Katharine McBride, and Marion Fay.

Discovery that disease-generating organisms known as PPLO (pleuropneumonialike organisms) are to be found in the saliva, throat cultures, and stools of human beings has been made by investigators in medical laboratories at the **University of Pennsylvania.** According to Harry E. Morton, Paul R. Leberman, and Paul Francis Smith, who conducted the research, this is the first recorded instance of PPLO having been isolated from the human body outside the genito-urinary tract. The significance of the discovery is that further investigations may lead ultimately to findings of importance in the field of infectious diseases. The organisms approach the filtrable viruses in size, and are at about the limit of visibility in modern microscopes which employ light for illumination. These factors may explain the many failures to recognize them as possible causes of infections in humans.

Meetings

The University of Texas at Austin will be host to the annual meeting of the southwestern section of the **American Association for Cancer Research** on December 8.

The American Institute of Chemical Engineers will hold its 43rd annual meeting in Columbus, Ohio, December 3–6. Seven symposia will cover such topics as ultrasonics, chemical engineering in the glass industry, phase equilibria, processing of viscous materials, and air-pollution control.

G. H. Laramie, of the New Hampshire Department of Agriculture, was elected president of the **Association of Seed Control Officials** of the northeastern states, at the group's second annual meeting, held November 8 at the Connecticut Agricultural Experiment Station. He succeeds A. Warren Clapp, of the Massachusetts Department of Agriculture. Other officers elected were: vice president, P. M. Eastman, of the New York State Department of Farms and Markets; and secretary-treasurer, John L. Clough, of the Delaware State Board of Agriculture. Officials representing nine of the northeastern states and Washington, D. C., attended the meeting, during which much of the discussion centered around the proper qualifications for candidates for seed inspection positions. A tentative list of standards for such posts was drawn up by the group.

Marvin Fisher, Jr., M. Stanley Helm, and Max A. Faucett, speaking at the fall meeting of the **American Institute of Electrical Engineers** in the Skirvin Hotel, Oklahoma City, told how to combat light flickering caused by electric welding machines. They reported that the University of Illinois Engineering Experiment Station will soon issue a bulletin with tables from which power engineers can quickly compute the size of wires and amount of current needed to prevent the flicker. The solution was worked out in a cooperative research project of the university and the Utilities Research Commission of Chicago.

The American Statistical Society will hold its 110th annual meeting at the Congress Hotel in Chicago, December 27–29. The program includes joint meetings with the American Association of University Teachers of Insurance, American Economic Association, American Farm Economic Association, American Finance Association, American Marketing Association, American Psychological Association, American Public Health Association, American Society for Quality Control (Chicago section), Association for Computing Machinery, Biometric Society (ENAR), Econometric Society, Industrial Relations Research Association, Institute of Mathematical Statistics, Population Association of America, and the Psychometric Society. Reservations should be sent to Daniel Amico, Congress Hotel, Chicago 5.

In the Laboratories

A new $10,000 rubber research laboratory has been established at **Armour Research Foundation** of Illinois Institute of Technology. Specific projects now in progress include custom compounding of rubber stocks for specialized uses and a basic study of new types of petroleum oils and resins in the compounding of rubber. Alfred G. Susie, supervisor of rubber and plastics research at the foundation, said that a staff of rubber specialists will work with both crude-natural and synthetic rubbers. "The retraction or 'snap-back' quality of uncured rubber is very limited," Dr. Susie explained. "By proper compounding, we can not only improve the retraction qualities but also build in a resistance to heat build-up, abrasion, ozone, strain, etc."

The first antibiotic animal feed supplement, Bi-Con TM-5, containing terramycin, has been announced by **Chas. Pfizer & Co.** Extensive tests carried out by scientists at various state colleges, particularly at Washington State and Iowa State, and in Pfizer's laboratories have shown that certain antibiotic residues promote growth of chickens, turkeys, and swine. The "broad spectrum," or wide-range antibiotics, such as terramycin, were shown to be relatively more effective in animal nutrition than such antibiotics as penicillin and streptomycin.

A general research laboratory, to handle chemical, microscopical, and physical work on problems of cement and cement manufacture, is being established at the Des Moines, Iowa, plant of the **Marquette Cement Manufacturing Co.**, to be under the general supervision of technical director C. E. Wuerpel. New personnel recently added to staff this laboratory include Charles U. Pierson, Jr., formerly with the Portland Cement Association, who will be chief research assistant to Wuerpel; Erwin C. Hoeman, formerly on the technical staff of Battelle Memorial Institute, who will be research chemist; and assistant research chemist, William E. Woody, graduate chemical engineer from Iowa State College.

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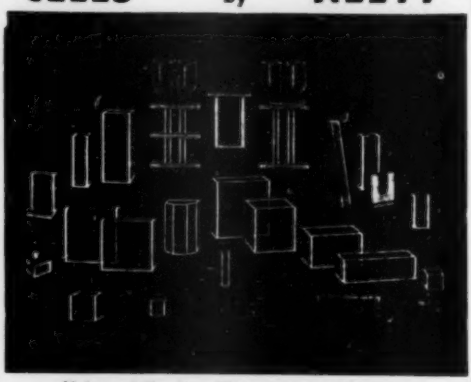

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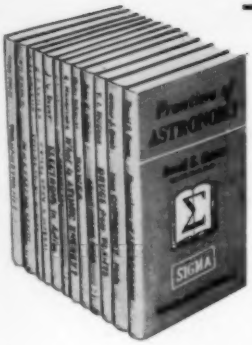

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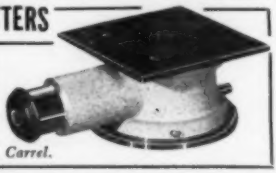

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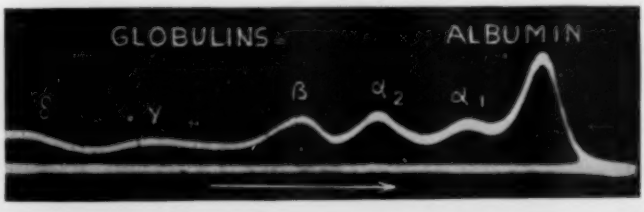

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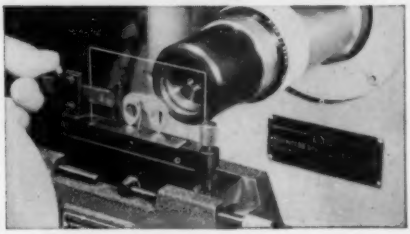

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